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HUMAN RESOURCES

VALIDATION AND REESTIMATION OF AN AIR FORCE REENLISTMENT ANALYSIS MODEL

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13. ABSTRACT *(Maximum 200 words)*
This paper describes the validation and reestimation of an econometric model to predict enlisted retention rates and their effect on Air Force Specialty (AFS) force structures. The econometric model estimated and developed in 1985 used data from January 1974 to March 1982. As reenlistment data since 1982 were available, the Air Force Human Resources Laboratory initiated work to validate the model. Approximately one-third of the equations were found to consistently underpredict the unusually high reenlistment rates which occurred from April 1982 to June 1986. To improve the predictive capability of the econometric model, several changes were introduced into the model: expansion of the database to include the April 1982 to June 1986 reenlistment decisions, a stronger link of civilian wage to demographic and industrial variables and the introduction of seven new explanatory variables. These changes produced an econometric model with a much lower level of bias and the model was subsequently incorporated in the Air Force Retention Analysis Package (AFRAP), a manpower and personnel force modeling decision aid.

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SUMMARY

In the early 1980's AFHRL undertook a research project to model enlisted retention using demographic and economic predictors and incorporated the results in a computerized decision tool used by Air Force personnel planners and decision makers. The Air Force Retention Analysis Package (AFRAP) is discussed in an AFHRL technical paper, Air Force Retention Analysis Package: Users Manual (AFHRL-TR-89-10, AD-A212 767). The underlying econometric model was completed in 1985, using reenlistment, pay and policy data from January 1974 to March 1982. As the unusually high retention patterns of the early 1980's continued into the mid-80's, AFHRL began work to validate the econometric equations using reenlistment data from April 1982 to June 1986.

The econometric model was reestimated with a number of changes including seven new variables; recalculation of civilian wage as a function of age, sex, race, education level and industry-wide wages; and the expansion of the data base to include reenlistment decisions made since March 1982. Of the new variables, three accounted for seasonality in the data, one reflected post-Vietnam attitude towards the military, two variables accounted for prior knowledge of impending changes in the bonus, and one modified the form used to model changes in the employment rate. These enhancements produced a more robust model of reenlistment, reducing the tendency to underestimate reenlistment rates, and resulting in a more defensible and effective reenlistment model.

PREFACE

The validated and reestimated econometric model of Air Force enlisted retention behavior presented in this paper is part of the Air Force Human Resources Laboratory Force Management Program. The econometric model underlies the Air Force Retention Analysis Package (AFRAP) decision tool being incorporated in Air Force and OASD force management and policy analysis systems. This enhanced econometric model and resulting AFRAP software will provide Air Force personnel policy and decision makers a defensible and effective management tool.

The authors wish to thank Dr. Thomas R. Saving and Dr. Guy Curry for technical assistance and guidance in this research project, Mrs. Kathy Berry and her staff for typing and editing the manual and Ms. Rebecca Wortman for her review of this paper.

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I. INTRODUCTION

Since 1982, the Air Force Human Resources Laboratory (AFHRL) has been conducting research to build an econometric model of reenlistment behavior. This model was developed and tested effectively on reenlistment decisions made from 1974 to 1982 (Saving, Stone, Looper & Taylor, 1985). The resulting econometric equations were incorporated into the Air Force Reenlistment Analysis Package (AFRAP), an interactive software routine designed to permit users to investigate the effects of changes in economic and demographic variables on predicted reenlistment rates in specific five-digit Air Force Specialties (AFSs). In addition, AFRAP was designed to project the impact of these changes on the force distribution by year groups in each AFS. The reenlistment prediction equations were developed at the five-digit AFS level across the first, second, and career reenlistment decision points.

The technique used to estimate the reenlistment equations was a maximum-likelihood estimated model, called probit, which has a binary dependent variable representing an airman's choice: 1 if the airman reenlisted and 0 if the airman separated. The equations estimated the probability of an airman reenlisting, or the rate at which a group of airmen would reenlist given a set of demographic and economic conditions relevant at the time of the decision. The conditions captured in the explanatory variables included military compensation, employment rate, comparable civilian wage, number of dependents, marital status, education level, mental category, race, and sex.

Section II of this paper presents the results of validating the reenlistment equations from Saving et al. (1985) against more recent reenlistment decisions. Several statistics were calculated to determine both the deviation of forecasted reenlistment rates from their actual value and the deviation of predicted individual reenlistment decisions from the actual decisions. The statistical measures used for the forecasting validation were the Coefficient of Multiple Determination referred to as the Simulation R^2 (SR^2), Ex Post Root-Mean-Square Forecast Error (RMSE), Theil's Inequality Coefficient (TIC) and its three components (Bias, Variance, and Covariance), Janus Coefficient (JC), and Percent Successful Predictions (PSP).

Based on the evaluation of these measures, the reenlistment equations were re-estimated to improve their forecasting capability. The new equations were then validated using the statistics in Section II. Section III presents the results of the re-estimation and validation. Section IV summarizes the findings and presents recommendations for future enlisted force retention analysis.

II. VALIDATION OF THE REENLISTMENT EQUATIONS

Several different measures of forecasting credibility are presented in this section to analyze how accurately the reenlistment equations in AFRAP (Saving et al., 1985) forecast quarterly reenlistment rates. Appendix A presents a definition and brief discussion of each statistic. The statistics were used to identify forecasting problems encountered in the simulations, and any inconsistencies among the statistics were examined. A brief discussion of the data will follow to help clarify some of the problems encountered in forecasting reenlistment rates.

Data

The reenlistment equations were originally estimated using data on individual airman and their reenlistment decisions made from January 1974 to March 1982 (referred to as the original sample). The validation process used data on airmen making reenlistment decisions from April 1982 to March 1986 (referred to as new sample). Calendar quarters were used as the basis for the time periods. Equations for all three categories of enlistment were validated: 115 AFS equations for first term, 33 equations for second term, and 34 equations for career. First term results are the most meaningful for discussion since that decision point is the crucial one for entry into the career force and little variation occurred in the reenlistment rates for second and career terms. Hence, the focus of this paper will be on predicting first-term quarterly reenlistment rates.

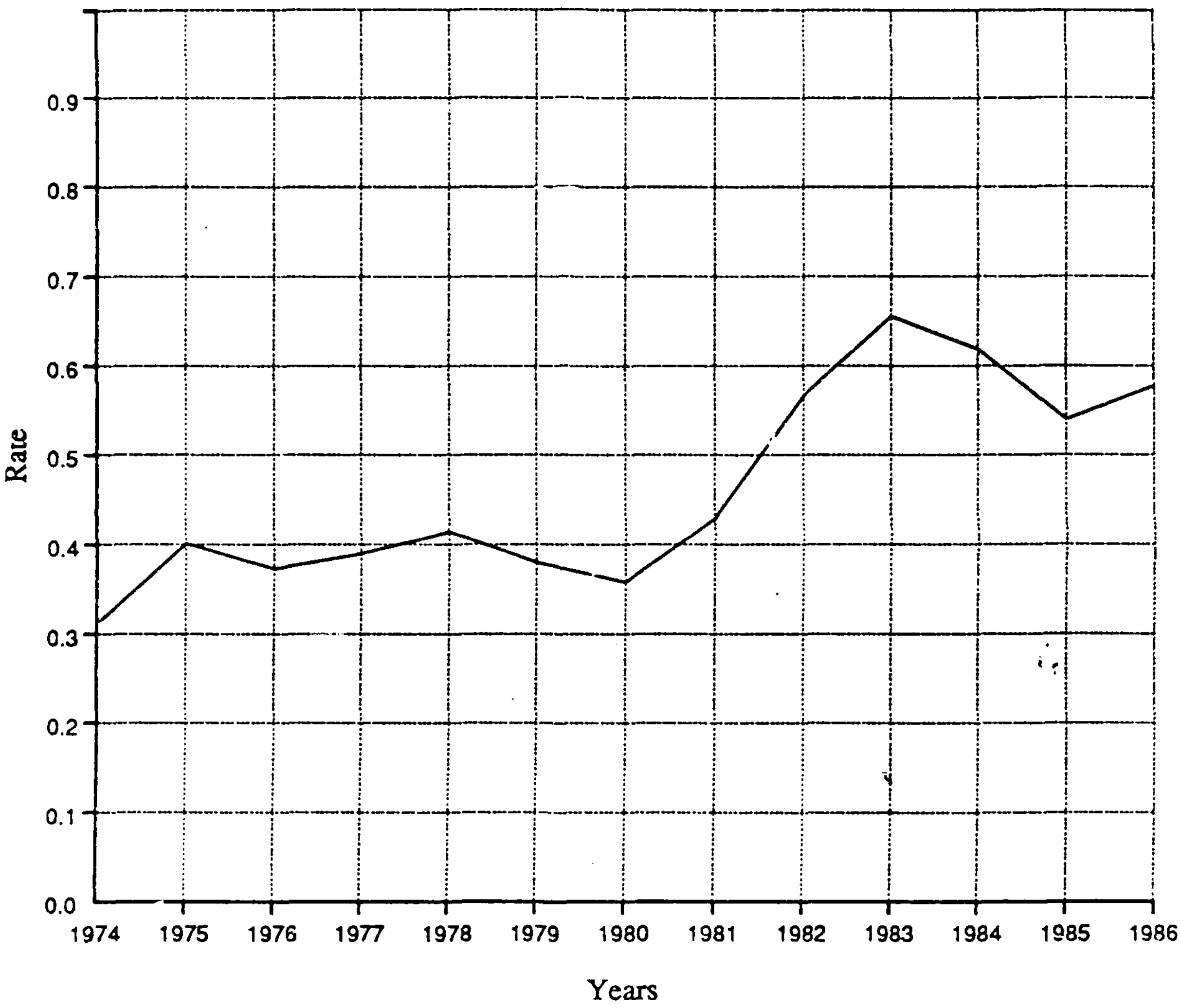
Background

During the early to mid 1980's, Air Force first term reenlistment rates reached historical highs, as can be seen in Figure 1. For example, the reenlistment rate for fiscal year 1982 (FY82) was 56.7% and for FY83 was 65.6%, while reenlistment rates prior to FY81 were rarely over 40%. FY81 marked the beginning of a six-year time period (FY81 to FY86) in which reenlistment rates averaged 56.5%.

During the first few years of the new sample period, the economic environment of the private sector provided limited career opportunities and uncertainty for enlisted personnel who were at the first decision-making juncture in their career. As Figure 2 indicates, the new sample period was initially one of high unemployment for the 20 to 24 year old male civilian labor force, limiting the number of career options available to enlisted decision makers, especially first termers. By the end of calender year 1985, the 20-to-24 year-old male unemployment rate had fallen to a pre-1980 levels of 10 to 12%. Reenlistment rates had not adjusted to the new employment opportunities which were arising in the mid-1980's.

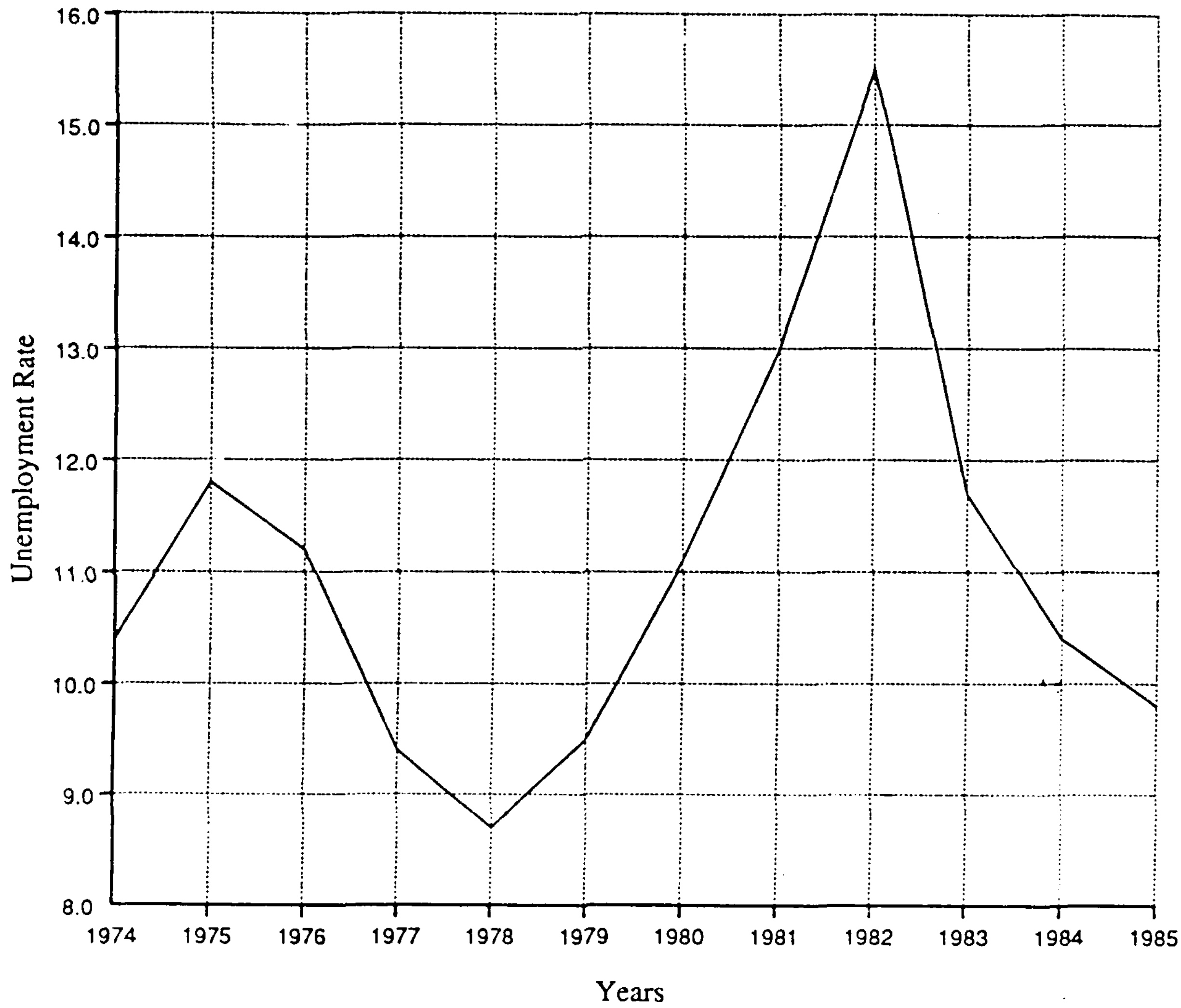
The high unemployment rates during the initial part of new sample period, the substantial military pay raises in the early 1980's (11.7% in October, 1980 and 14.3% in October, 1981), and the slow adjustment by individual reenlistment decision-makers to an improving economy were key reasons for the improved reenlistment rates of the 1980's. The average reenlistment rate for the original sample was approximately 39.9% versus 59.1% for the new sample. This considerable difference between the average reenlistment rates for the original versus new samples contributed to problems in forecasting over the new sample period.

The differences in actual reenlistment rates between the original and new samples varied among the AFSs. For example, AFS 272x0 (Air Traffic Control) experienced an average reenlistment rate of 48.7% over the original sample period versus 55.4% over the new sample period. However, the difference was considerably larger for AFS 702x0 (Administration), which exhibited rates of 46.4% for the original sample and 69.4% for the new sample. In all cases, the rates for the new sample were higher than those for the original sample, even for such high-demand career fields as computer operators and computer programmers, which had percentage point differences of 8.8 and 12.5, respectively.



Source: Historical Airman Data Base (Saving et al., 1985).

Figure 1. Historical Fiscal Year Reenlistment Rates for First-Term Airmen.



Source: Historical Airman Data Base (Saving et al., 1985).

Figure 2. End of Calendar Year Unemployment Rates for 20-to-24 Year-Old-Males.

In addition to the rising reenlistment rates, the Air Force also experienced a slight increase in the end-of-fiscal-year force levels. The force level increased approximately 2% from FY81 to FY82 and 1% from FY82 to FY83, declining to a 0.5% increase from FY84 to FY85. This modest overall rise in force levels of 2.5% paralleled consistently high reenlistment rates, resulting in reductions in manning shortages and less dependence on selective reenlistment bonuses.

Bias

As previously shown, reenlistment rates for all categories of enlistment were extremely high during the new sample period. This led to a tendency to underestimate the reenlistment rates for the new sample period. The mean error (ME) and the bias statistic from TICs (Theil, 1966) were used to determine if a persistent bias existed in the new sample simulations. The ME between the actual and the predicted reenlistment rates indicates whether or not the prediction tends to over- or underestimate the actual rate. The bias statistic ranges between 0.0 and 1.0 and indicates whether the bias is persistent. The closer the ME is to 0.0 the less likely the occurrence of a persistent bias.

For these equations, the ME averaged 0.129 with a standard deviation of 0.131. Only 13 of the 115 equations exhibited a tendency for overestimation. Ten of these equations were considered serious bias problems, using 0.1 as the criteria for identifying a consistent bias (Pindyck & Rubinfeld, 1981). Of the 102 equations that exhibited a tendency to underestimate the reenlistment rate, 92 of the equations were considered persistent under the 0.1 criteria. Thus, the prediction equations tended to persistently underestimate the reenlistment rates for the April 1982 to March 1986 time period. This is not surprising given the historically high reenlistment rates for this time period. Figure 3 presents an example of a persistent prediction bias exhibited by AFS 431x1 which typifies the bias problems across AFSs. The mean quarterly prediction for AFS 431x1 was 0.420 while the actual mean for the new sample period was 0.535. The prediction was, on average, 10 percentage points lower than the actual reenlistment rate.

Simulation R^2

Simulation R^2 (SR^2) measures how well the estimation equation predicts compared to the actual sample mean and has a value between minus infinity and 1.0. A negative number indicates that the prediction error, on average, is larger than the difference between the mean and actual reenlistment rate. The larger the negative number, the larger the error. Of course, one could never forecast with the sample mean because one does not know the sample mean, a priori. Given the known bias in the data, the SR^2 was an important measure of the forecasting credibility of the estimation equations.

The mean value for SR^2 across 115 first term equations was -0.941 with a standard deviation of 2.665. The new sample SR^2s indicate that only 17 equations predicted better than the mean reenlistment rate, i.e., they exhibited a positive SR^2 value. Using SR^2 as a guideline, the reenlistment equations which performed well still tended to exhibit an underestimation bias. Twelve of these equations exhibited a bias using the 0.1 criteria for the bias statistic.

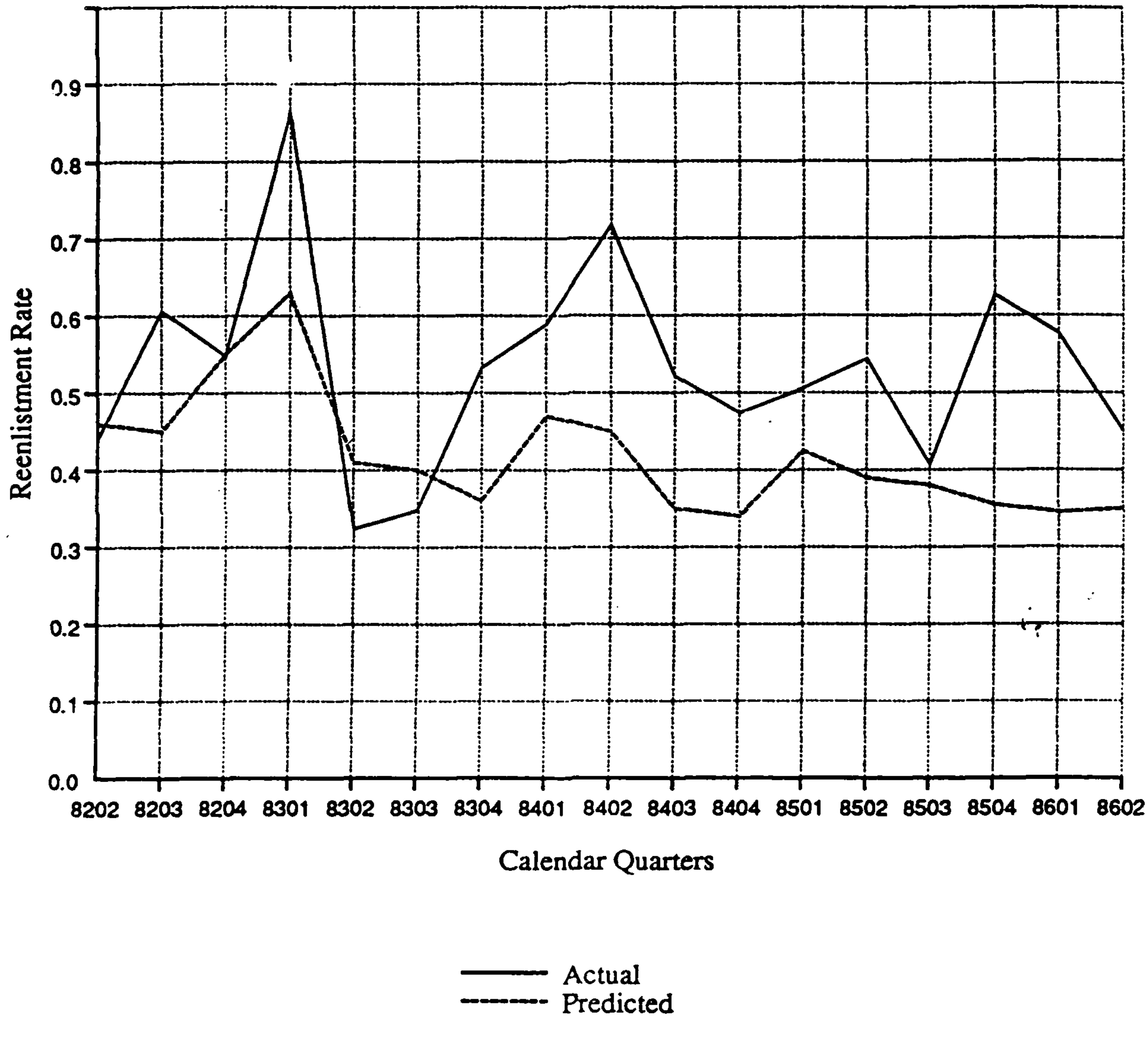


Figure 3. Actual Versus Predicted Quarterly Reenlistment Rates for AFS 431x1 .

Thus, SR^2 exhibited generally unfavorable results, largely due to the significant differences in the actual mean reenlistment rates between the original and new sample periods. Substituting the actual mean reenlistment rate from the original sample for the actual mean reenlistment rate from the new sample in the calculation of SR^2 resulted in a significant improvement. The revised computation using the original sample rate improved the new sample SR^2s from a mean value of -0.941 to 0.310. Over 76% of the equations predicted better than the actual mean rate for the original sample. Of the 98 reenlistment equations which did not predict better than using the new sample mean reenlistment rates, only five did not predict better than the original sample mean reenlistment rate was used.

Janus Quotient

The poor performance of the equations over the new sample as shown by low SR^2s was not necessarily a reflection of a poor original sample prediction equation. A statistic which compares the level of forecasting accuracy between new and original sample predictions is the Janus Quotient (JQ). The JQ is the ratio of the sum of the differences between actual and predicted reenlistment rates in the new sample to the sum of the differences between actual and predicted reenlistment rates in the original sample. The value for the JQ ranges between 0.0 and infinity with a value of 1.0 or less indicating that the prediction of the equation over the original sample period exhibits the same or lower level of error than over the new sample period. Eleven of the AFSs had a JQ value of below 1.0, and 33 of the 115 AFSs (30.4%) had a JQ value of less than 2.0, which was still quite acceptable (Koutsoyiannis, 1977). Both the mean and median JQ values were high, 4.264 and 3.141, respectively. If the eight worst AFSs exhibiting a JQ value above 10 were excluded, then the mean JQ value improved to 3.479.

Root-Mean-Square Simulation Error

The Root-Mean-Square Simulation Error (RMSE) measures the deviation of the simulated variable from its actual path (Koutsoyiannis, 1977). RMSE ranges between 0.0 and infinity with 0.0 indicating no forecasting error. The mean value for the RMSE was 0.217 with a standard deviation of 0.080. The median value for RMSE was 0.199 exhibited by AFS 622x0 (Food Services). For those AFSs exhibiting a persistent bias, the mean RMSE was 0.227 versus a mean RMSE of 0.140 for those AFSs without a persistent bias.

Theil's Inequality Coefficient and Its Components

Theil's Inequality Coefficient (TIC) is often applied to new sample forecasts, and it can also be reduced to its three components to provide additional insight into determining weaknesses in the forecasting models. One of the components, the bias statistic, was discussed earlier. TIC ranges in value from 0.0 to 1.0 with 0.0 representing a perfect forecast. The new sample values for TIC averaged 0.228 with a standard deviation of 0.125. The median value was 0.194 for AFS 631x0 (Fuel) with 25% of the equations exhibiting a TIC of 0.146 or less.

TICs computed for the original sample averaged 0.151, 30% less than the mean TIC for the new sample. A ranking of the original and new sample TICs (see Table 1) provided a Spearman's coefficient of rank correlation of 0.288, which is statistically significant at the 95% level of confidence. However, a low TIC value for the original sample did not necessarily insure a low TIC value for the new sample.

The variance component of TIC measures the ability of the equations to accurately predict the degree of variability in the reenlistment rates. The variance ranges between 0.0 and 1.0 with 0.0 representing perfect prediction of the variability. The variance component averaged 0.151 for the new sample with a standard deviation of 0.138, suggesting that although some of the equations poorly forecasted the level of variability, 57 of the equations had a variance component of less than 0.1, an acceptable cutoff level (Pindyck & Rubinfeld, 1981). Large upward or downward variations in the quarterly reenlistment rates did occur during the new sample period, often resulting in large prediction errors. The variance component indicated that the large upward or downward variations did not tend to dominate the new sample forecasts.

The covariance component of TIC measures the degree of unsystematic error. The covariance ranges between 0.0 and 1.0 with 1.0 representing the best covariance value. The covariance is more likely to capture the unusually large variations in the reenlistment rates. The covariance component averaged 0.333 with a standard deviation of 0.246 for the new sample predictions. This low value represents the difficulty encountered by the reenlistment equations in predicting the historically high reenlistment rates which occurred during the new sample period.

Table 2 provides a comparison of the validation statistics. Overall, the statistics reflect the general inability of the equations to predict the new sample period. The minimum value for RMSE indicates that not all equations encountered trouble predicting the new sample. The minimum value is 0.090, and the value one standard deviation below the mean is 0.137. The mean value for the bias statistic is large enough such that one standard deviation below the mean, 0.242, is still at an unacceptable level of bias.

Percent Successful Predictions

The percent of individual airmen which the equations correctly predicted to either reenlist or separate averaged 60.5% with a standard deviation of 6.1 percentage points. The equations correctly predicted 73.1% of the reenlistment/separation decisions over the original sample period. The percent successful predictions for the new sample period ranged as high as 79.9% for AFS 751x2 (Training) and as low as 38.5% for AFS 672x1 (General Accounting).

Small Sample Sizes

One problem that was prevalent in over 25% of the first term career fields was the small number of reenlistment/separation decisions made per quarter. The problems caused by a small number of observations is that large swing in the

Table 1. Comparison of the Original Versus New Sample TIC[a] Rankings

Original sample	AFSC	New sample	Original sample	AFSC	New sample
1	431x2	30	13	751x2	1
2	274x0	2	2	274x0	2
3	732x0	49	49	741x1	3
4	702x0	17	44	304x4	4
5	431x1	14	89	472x2	5
6	201x0	24	32	602x1	6
7	431x0	41	20	423x0	7
8	602x0	22	64	423x3	8
9	112x0	42	11	423x5	9
10	472x1	38	18	272x0	10
11	423x5	9	80	427x4	11
12	426x2	86	16	651x0	12
13	751x2	1	86	871x0	13
14	423x4	65	5	431x1	14
15	906x0	92	78	304x1	15
16	651x0	12	63	391x0	16
17	427x2	63	4	702x0	17
18	272x0	10	73	231x1	18
19	631x0	60	36	908x0	19
20	423x0	7	31	271x1	20
21	622x0	56	79	427x1	21
22	511x0	70	8	602x0	22
23	462x0	64	75	362x4	23
24	542x2	43	6	201x0	24
25	461x0	93	52	271x2	25
26	122x0	34	76	326x4	26
27	427x5	53	91	566x1	27
28	423x2	37	37	276x0	28
29	293x3	61	47	552x0	29
30	811x0	77	1	431x2	30

[a]Spearman's Rank Order Correlation Coefficient is 0.288 which is statistically significant at the 95% level of confidence.

Table 2. Comparision of Validation Statistics

Original Equation

	Mean	SD	Minimum	Maximum
ME	.129	.131	-.372	.489
Absolute Mean Error	.187	.079	.075	.489
RMSE	.217	.080	.090	.506
SR^2	-.941	2.665	-9.999	.929
TIC	.228	.125	.086	.837
Bias	.516	.274	.000	.948
Variance	.151	.138	.000	.573
Covariance	.333	.246	.014	.958

reenlistment rates were attributable more to the small numbers of decision makers than to the economic or demographic variation and therefore not as predictable.

Across the 115 first-term reenlistment equations, the average number of observations per quarter ranged from a low of 9 to a high of 520. The smallest 25% (in terms of average number of quarterly observations) averaged only 17.8 observations per quarter compared to an average of 208.5 for the largest 25% career fields. Even though the mean reenlistment rates were nearly the same for the smallest and largest groups, the standard deviations of the those rates were significantly different. The standard deviation for the smallest group was 0.180 compared to a standard deviation of 0.107 for the largest group. This problem was also reflected in the TIC statistic. The smallest group had an average new sample TIC of 0.294 versus 0.193 for the largest group. The new sample TIC averaged 0.228 across all 115 AFSs, but of the 18 AFSs with an average of less than 20 observations per quarter, only 4 exhibited a new sample TIC which was less than 0.2.

Second Term and Career Validation Results

A brief look at second and career term results reveals that they were not as amenable to validation as first-term equations because of the lack of variation in reenlistment rates across time periods for second term and career. The mean reenlistment rates for second-term AFSs ranged from a low of 0.739 with a standard deviation of 0.090 for 272x0 (Air Traffic Controllers) to a high of 0.901 with a standard deviation of 0.045 for 995x0 (Recruiter). The career term exhibited even less variation about the mean. The lowest mean reenlistment rate in the career term was 0.960 with a standard deviation of 0.028, exhibited by 902x0 (Medical Service). The highest mean reenlistment rate in the career term was 0.997 with a standard deviation of 0.008, exhibited by 114x0 (Aircraft Loadmaster). With such minimal variation around the mean, it was difficult for an explanatory equation to improve a prediction using the mean. In the career term, six equations performed better than the mean reenlistment rate for the new sample as indicated by the SR^2s. The second term had similar results, with eight equations predicting better than the mean reenlistment rate for the new sample.

III. RE-ESTIMATION OF THE REENLISTMENT EQUATIONS

The results from Section II can be summarized by the following three problems identified in the forecasting of first-term reenlistment rates using the original Saving et al. (1985) equations to predict reenlistment decisions made in the new sample period:

1. Significant differences between the new and original sample mean reenlistment rates contributed to a persistent bias tendency in forecasting the new sample reenlistment decisions.

2. Reenlistment rates for many AFSs exhibited large swings which were not readily explainable by the reenlistment equations.

3. AFSs with a small number of transactions per time period exhibited significantly higher variations in reenlistment rates than AFSs with large numbers of reenlistment decisions. Thus, the smaller AFSs were more difficult to predict.

Each of these problems was resolved to some degree through re-estimation of the original reenlistment equations by using new predictor variables and/or additional time periods.

The newly estimated equations were also validated to determine the level of overall improvement in the predictive capability of the reenlistment equations for the new sample period, as well as the entire sample period (January 1975 through March 1986). The original data for the calendar year 1974 were found to be miscoded for reenlistments and thus were eliminated from the sample. Since minimal variation occurred in the reenlistment rates for second term and career, the focus of this section will again be on the first-term reenlistment estimation equations.

New Reenlistment Equation

Several new variables were added to the reenlistment equations to enhance their forecasting credibility. Seasonal variables were included for the fiscal quarters of the year to account for large swings in the reenlistment rates due to seasonal variations, e.g., end of fiscal year adjustments in the fourth quarter. Included are first quarter (FYQTR1, October through December), second quarter (FYQTR2, January through March), and fourth quarter (FYQTR4, July through September), with the third quarter of the fiscal year (April through June) implicit.

The calculation of civilian wage was improved by using age earning functions based on race, sex, academic education level, and industry. The new calculation more closely approximates the civilian earnings opportunities for enlisted personnel. An age earnings function was estimated for each of 12 demographic cohorts which were based on sex (male or female), race (Caucasian or non-Caucasian), and education level (non-high school graduate, high school graduate, or more than high school graduate). Each of the estimated functions had the relationship between earnings and age as shown in Figure 4.

A three-step procedure was used to adjust the age-earnings function for industry wages. First, using an average age for the civilian population, the appropriate age-earnings function was used to estimate the average earnings for the cohort in which the individual resided. Secondly, the difference between the average earnings and the industry wage for the time period was added to the intercept to produce an industry adjusted age-earnings function. Lastly, the age of the individual was used to estimate his/her expected flow of civilian earnings for the next 4 years using the industry adjusted age earnings function for the calculation. The expected flow of civilian earnings was discounted to the present using a 10% discount rate and deflated using the Consumer Price Index (CPI).

Two additional variables were added to the estimation equation to account for the change in reenlistment behavior due to anticipated changes in the Selective Reenlistment Bonus (SRB) multiple. For example, consider what might happen when

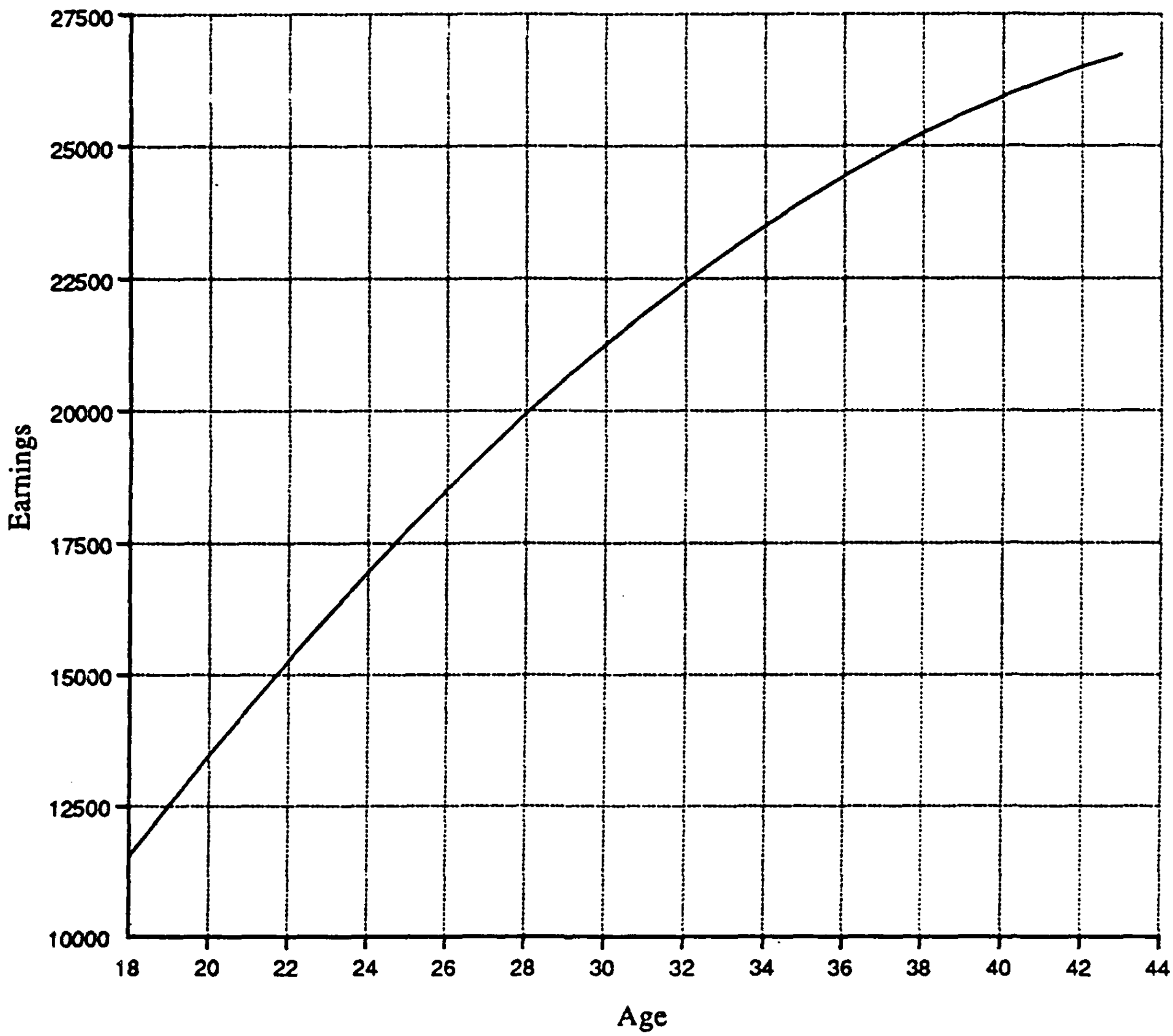


Figure 4. Age-Earnings Function.

an AFS presently paid an SRB equal to a multiple of 2.0 experiences a reduction in the SRB multiple to 1.0 in the next time period. Airmen who are presently eligible to reenlist within the next 12 months or less and already intend to reenlist, will reenlist in the present time period to take advantage of the higher SRB multiple. Thus, the reenlistment rate for the present time period will experience an increase, while the reenlistment rate for the next time period will experience a decrease due to people changing the timing of their decision to reenlist. The coefficient for BONUS measures the change in the reenlistment rate due to a change in the SRB multiple. The reenlistment rate would be expected to fall when the SRB multiple is decreased, but unless the change in the reenlistment rate due to the timing of decisions is accounted for in the estimation of the BONUS coefficient, the estimated coefficient will be biased.

To eliminate this bias in the BONUS coefficient, leading and lagging variables were included for those time periods in which the SRB multiple changed. BFOR was a variable equal to the change in BONUS from the present to the next time period, while BPAS was equal to the change in BONUS from the previous to the present time period. For those time periods in which the future or past time periods experienced no change in SRB multiple, the values of BFOR or BPAS were zero. The expected relationship between reenlistment and BFOR is inverse, i.e., increases (decreases) in the SRB multiple in the next time period cause decreases (increases) in the reenlistment rate in the present time period. The expected relationship for BPAS is direct, i.e., increase (decreases) in the SRB multiple from the last time period to the present time period cause the reenlistment rate in the present time period to increase (decrease).

The last variable added to the reenlistment equation represented the change in attitude toward military service since the end of the Vietnam War. ATUD is an exponentially declining function of the amount of time which has lapsed between the date of the decision to reenlist/separate and the end of the Vietnam War (August 1972, the date on which the last combat troops left South Vietnam). ATUD is expressed as

$$\mathrm{ATUD} = (e^{-((t-c)/12)}) * 1000$$

where e is the base of the natural system of logarithms (2.71828...), t is the time period of the reenlistment/separation decision, and c is the date identified as the end of the Vietnam War. The expected relationship for ATUD is inverse since reenlistment rates should increase the farther removed the decision to reenlist/separate is from the Vietnam War. Also, the value of ATUD declines as t-c increases. Figure 5 demonstrates the relationship between ATUD and time. ATUD was multiplied by 1,000 to minimize the problem of estimating the probit model with a variable which declines in value rapidly.

The final modification made to the explanatory variables was with REMP. In the original study (Saving et al., 1985), REMP exhibited inconsistency, with 33.3% of the equations displaying a statistically significant negative relationship, but with 12.8% showing a positive significant relationship. The square of REMP was added to better explain the relationship between reenlistment/separation decisions. The quadratic form is shown in Figure 6. The expectation is that REMP is inversely

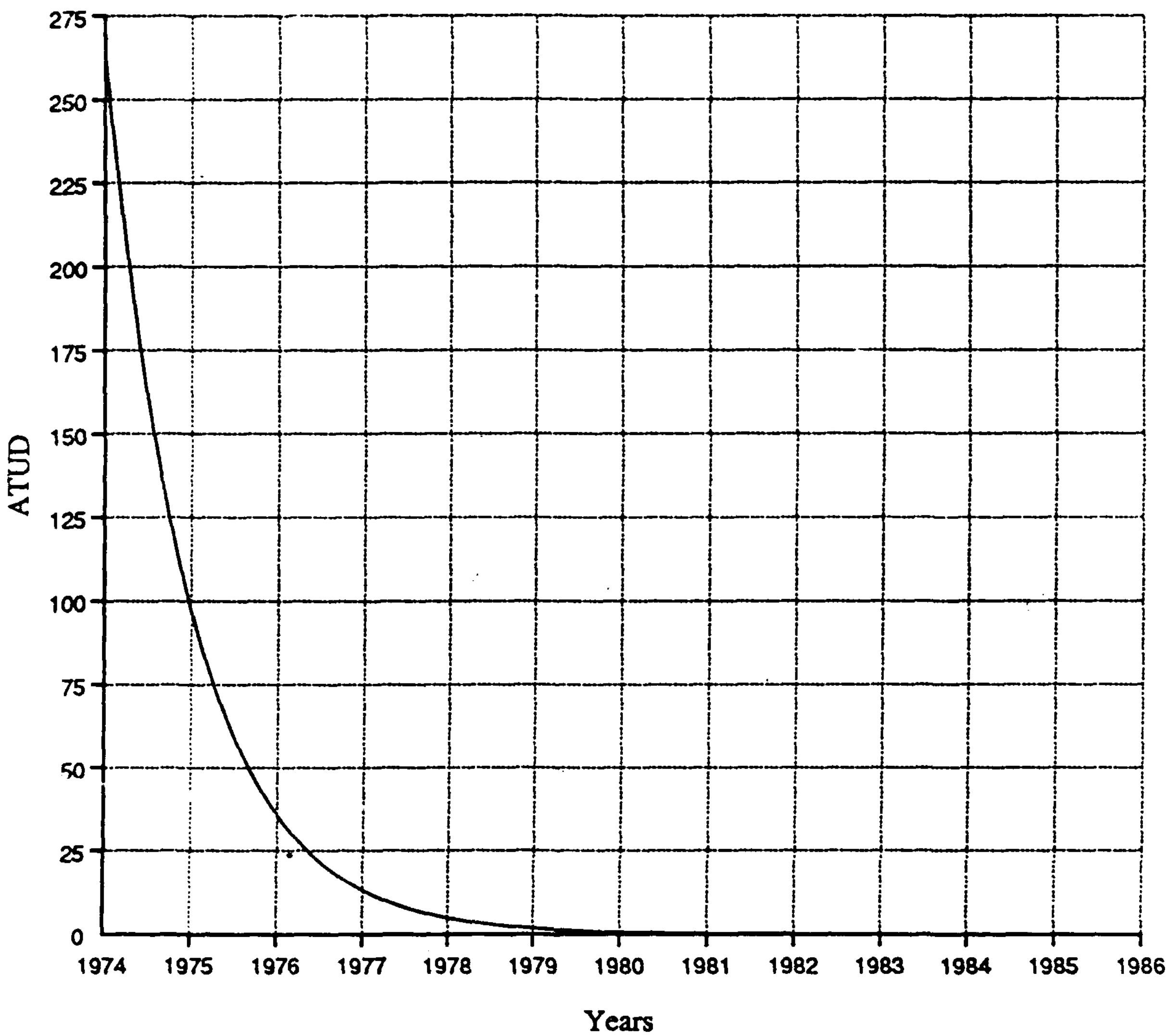


Figure 5. The ATUD Variable.

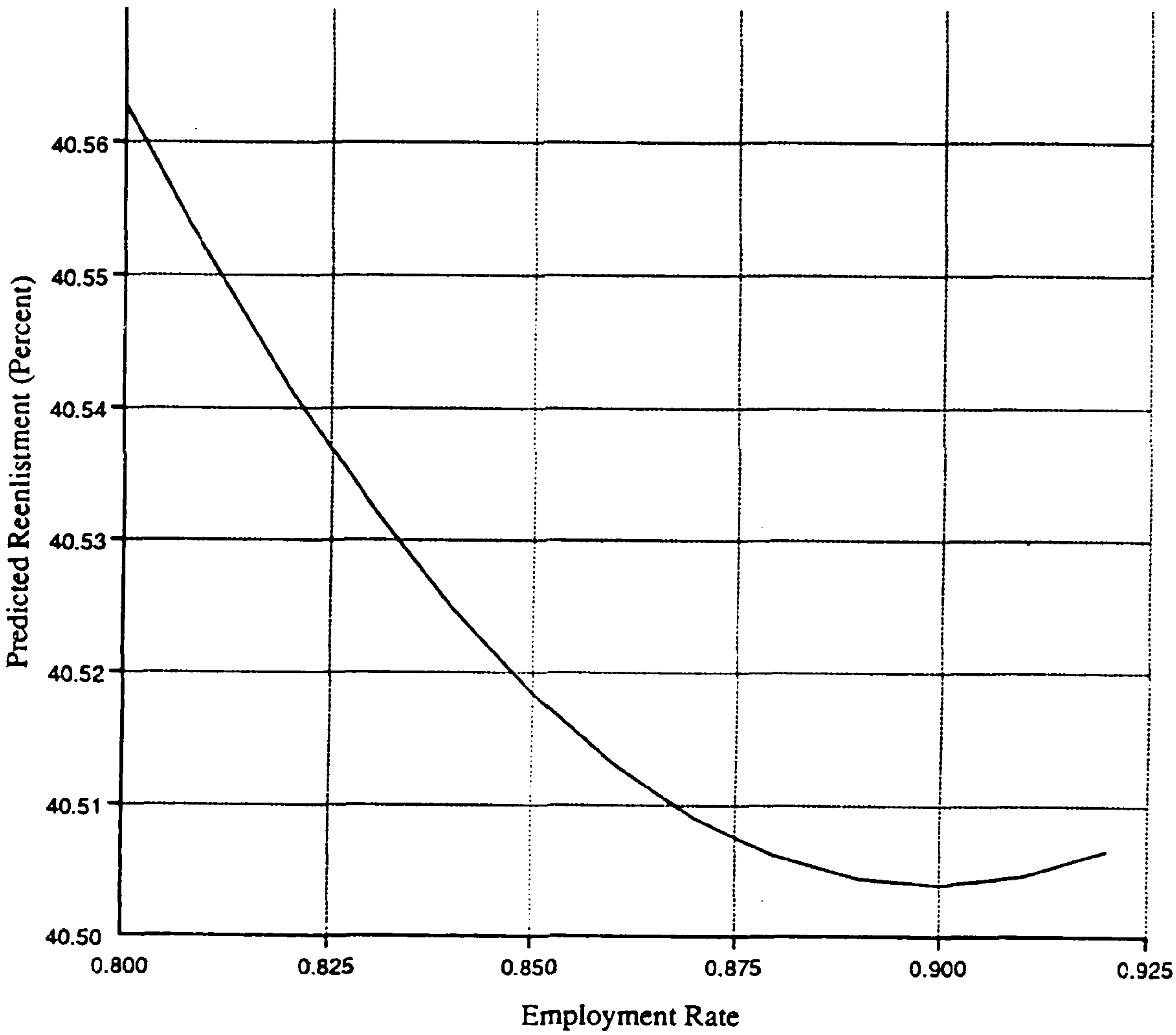


Figure 6. The Quadratic REMP Variable.

related to reenlistment over the range of reenlistment rates which are relevant for the combined original and new sample time periods.

Probit Estimation Results

In general, the explanatory variables which were a part of the original estimation equations performed approximately the same as in the original equations (Saving et al., 1985). Table 3 presents a summary of the first term results. Due to the remapping of several AFSs, the number of estimated equations dropped from 115 to 113. CWAGE and REMP were the only explanatory variables to display different results than the original equations. The proportion of equations with negative and statistically significant CWAGE declined from 80.3% to 47.8%. Given the new methodology for calculating CWAGE, this result is surprising. The extension of the estimation time period may have contributed to this change in CWAGE, but further analysis is required to determine the primary causes of the inconsistent showing of CWAGE.

Since REMP has an hypothesized inverse relationship with reenlistment, the downward portion of the curve should be over the relevant range for the mean value of REMP. To determine the relationship between reenlistment and REMP, inflection points were calculated to determine whether the mean value for REMP was in the upward or downward sloping portion of the curve. REMP and REMP2 were both statistically significant in 30 of the AFSs. The mean value for REMP was in the negative portion in 13 of the cases, in the positive portion in 15 of the cases, and was at the inflection point in 2 cases. As with the previous study (Saving et al., 1985), REMP continued to exhibit instability at the disaggregated AFS level compared to the aggregate level (DeVany & Saving, 1982).

In general, the new variables performed as expected. ATUD was negative and statistically significant in 92% of the equations, BFOR was negative and statistically significant in 30% of the equations, and BPAS was positive and statistically significant in 51.9% of the equations. The first and last quarters of the fiscal year exhibited the most consistent influence on reenlistments. FYQTR1 was negative and statistically significant in 40.7% of the equations, and FYQTR4 was negative and statistically significant in 79.7% of the equations. FYQTR2 was statistically significant in 22% of the equations, 15.9% positive and 6.19% negative.

Forecasting Bias

During the new sample period, the reenlistment rates for all categories of enlistment were at historical highs. This led to the finding in Section II that the original reenlistment equations tended to underestimate the reenlistment rates for the new sample period.

To determine if a persistent bias still existed in the new sample simulations post re-estimation, the mean error (ME) and the bias statistic from TIC were used. The ME across the 113 first-term reenlistment equations averaged 0.037 with a standard deviation of approximately 0.044 over the new sample period (refer to Appendix B for a complete listing). The original 115 equations had an average ME of 0.129. Using the bias statistic, 22.1% (25 of 113) of all equations exhibited a

Table 3. Summary Table for First Term AFS Probit Results[a]

	New equation[b]		Original equation[c]	
	Percent negative	Percent positive	Percent negative	Percent positive
ACED	0.00	32.74	0.9	41.0
RACE	79.44	0.00	96.6	0.0
AFQT	11.11	49.47	1.7	49.6
DEPT	93.81	0.00	90.6	0.0
MARST	0.00	78.85	0.0	86.3
SEX	31.86[d]	4.42[d]	45.4[e]	2.8[e]
BONUS	72.70[f]	6.48[f]	75.6[g]	1.2[g]
BFOR	17.10[h]	30.30[h]	0.0	0.0
BPAS	51.90[i]	10.40[i]	---	---
RMC	78.76	0.00	70.9	0.0
TAFMS	0.00	100.00	0.0	96.6
CWAGE	7.96	47.79	0.9	80.3
REMP	8.85	18.58	12.8	33.3
REMP2	18.58	9.73	---	---
ATUD	0.88	92.04	---	---
FYQTR1	3.54	40.71	---	---
FYQTR2	15.93	6.19	---	---
FYQTR4	0.00	79.65	---	---

[a]Percentages provided for those coefficients which were statistically significant at the 90% level of confidence

[b]113 AFSs with sufficient observations for analysis; percent of 113 AFSs which are significant

[c]117 AFSs had sufficient observations for analysis; percent of 117 AFSs

[d]Only 107 AFSs had sufficient numbers of females for analysis

[e]Only 108 AFSs had sufficient number of females for analysis

[f]Only 77 AFSs had bonuses (SRB)

[g]Only 86 AFSs had bonuses (SRB)

[h]Only 76 AFSs had sufficient observations for BFOR

[i]Only 77 AFSs had sufficient observations for BPAS

tendency for overestimation. Four of the 25 were considered a serious bias problem using 0.1 as the criteria for identifying a consistent bias. Eighty-eight of the re-estimated equations exhibited a tendency to underestimate the reenlistment rate. Sixty-six of the equations were considered to have a persistent bias using the 0.1 criteria. The original equations had 10 persistent overestimators and 92 persistent underestimators.

Thus, the new prediction equations still exhibited a slight tendency for underestimation of the reenlistment rates for the new sample period but improved in their prediction capability. The magnitude of the bias problem decreased across AFSs. The underestimation bias, which caused problems with most of the validation statistics for the original reenlistment equations, did not pose as serious a problem with the new reenlistment equations.

Simulation R^2

New Sample Period

During the new sample period, 86 of the re-estimated reenlistment equations predicted better than the mean reenlistment rate, i.e., SR^2 was greater then 0.0. The original equations predicted better than the mean reenlistment rate in only 17 cases. The mean SR^2 across 113 first term reenlistment equations was 0.197 with a standard deviation of 0.453. This compared quite favorably with the mean value of -0.941 for the original equation projections. The maximum value for SR^2 was 0.849 for AFS 321x2 (Weapon Control Systems). Forty-four of those equations predicting better than the mean reenlistment rate exhibited a bias using the 0.1 criteria.

SR^2 provided better results for the entire sample than for the new sample. This was not surprising given the significant difference between the economic climates of the new and the original sample periods. The mean reenlistment rate for the original sample period was 0.402 with a standard deviation of 0.094. The mean reenlistment rate for the new sample period was 40.1% higher, with an average reenlistment rate of 0.564 and a standard deviation of 0.072.

Entire Sample Period

The reenlistment equations also were evaluated using reenlistment decisions made during the entire sample period which provided insight as to the predictive capability of the new equations within sample. The mean SR^2 for the entire sample period was 0.507 with a standard deviation of 0.139. The only significant difference between the equations occurred when the variable BONUS was in the model. The differences in the predictive capability between the two groups, as reflected in SR^2, suggested that the bonus prediction equations tended to be slightly stronger. The BONUS group had a 20.7% higher SR^2 than the non-BONUS group. The mean SR^2 for the 77 equations with BONUS during the entire sample period was 0.537 with a standard deviation of 0.128. The non-BONUS equations had a mean SR^2 of 0.444 with a standard deviation of 0.140.

The rationale for the superior performance of the BONUS group may lie in the specification of the equations for the two groups. The AFSs in the BONUS

group were career fields experiencing manning shortages at various points in time. To alleviate the manning shortages caused by low retention, the Air Force offers bonuses to induce larger numbers of reenlistments. The variation over time in the amount of bonus offered reflects both the attempt to fine tune the reenlistment rate necessary to support required manning levels and the responsiveness of personnel within career fields to the bonuses. The inclusion of the BONUS variable in the estimation equation for the BONUS group captured the systematic variation in the reenlistment rate attributable to the bonus.

Career fields that have not received bonuses to induce higher reenlistment rates have either experienced balanced personnel manning or overages. Theoretically, a career field that has an overage should receive a negative bonus to induce voluntary separations or retraining. Since a negative bonus is not possible within existing Air Force compensation policy, no directly measurable factor is presently available for properly tracking the influence of a negative bonus or the personnel policy of forced retraining. Thus, the random component in the variation of the reenlistment rates was larger in the non-BONUS group.

The covariance component of TIC is a statistic which measures this level of random variation not captured by the reenlistment projections of the equations. During the entire sample period, the covariance for the BONUS group was only 5.4% higher than that of the non-BONUS group, but during the high retention of the new sample period, the covariance for the BONUS group was 26.4% higher than that of the non-BONUS group. This is not surprising since the high retention time periods exhibited more tendencies for surplus manning rather than shortage manning within the career fields. The mean covariance were 0.875 and 0.830 for BONUS versus non-BONUS AFS groups, respectively, during the entire sample period.

The BONUS group had a mean covariance of 0.700 versus 0.554 for the non-BONUS group during the new sample period. The percent improvement in the covariance during the new sample period was further reinforced by the fact that the median value for the BONUS group was 0.717 (AFS 915x0, Medical Material Specialist) versus 0.529 for the non-BONUS group (AFS 551x0, Pavement Maintenance Specialist). The difference in covariance statistics between the BONUS and non-BONUS groups further emphasized the inability of the reenlistment equations to account for the effect of personnel policies to correct manning overages within non-BONUS career fields. Given the high reenlistment rates of the new sample period, one would expect a higher level of internal management to occur across the overage AFSs, and, thus, the larger difference between the covariance values for the BONUS versus non-BONUS groups over new sample periods gave evidence of this fact.

Root-Mean-Square Simulation Error

New Sample Period

For the new sample period, the RMSE exhibited a mean of 0.121 with a standard deviation of 0.039. This was 44.2% lower than the 0.217 mean (standard deviation of 0.080) RMSE exhibited by the original equations. The non-BONUS group exhibited only a 5.1% higher RMSE than the BONUS group but a 44.0% higher standard deviation. The non-BONUS group had a mean RMSE of 0.125 with a

standard deviation of 0.029 versus the BONUS group's mean RMSE of 0.119 with a standard deviation of 0.042. The difference in the two mean RMSEs was smaller than the 20.7% difference in the SR^2 between the two groups. The median value of RMSE for the non-BONUS group was 0.116 for AFS 571x0 (Fire Protection) versus a BONUS group median of 0.110 for AFS 811x0 (Security Police).

Entire Sample Period

The RMSE for the entire sample period averaged 0.122 with a standard deviation of 0.024. Though the RMSEs were approximately the same for both periods, the 59.3% higher standard deviation for the new sample reflected the effect of the difference in the mean reenlistment rates between the entire and the new samples. The longer estimation period tended to mitigate the high and low reenlistment rates when the equation was estimated. Predictions for time periods in which actual reenlistment rates were two or more standard deviations from the mean tended to be under- or overestimated unless a significant change in one or more of the explanatory variables precipitated the reenlistment rate. Only a slight difference was reflected in the RMSE between the non-BONUS and BONUS AFS groups. The non-BONUS group's RMSE was 1.7% higher than that of the BONUS group over the entire sample period. The mean for the non-BONUS group was 0.123 with a standard deviation of 0.022 versus a mean RMSE for the BONUS group of 0.121 with a standard deviation of 0.025.

Theil's Inequality Coefficient and Its Components

New Sample Period

The TIC values over the new sample period averaged 0.110 with a standard deviation of 0.044. This indicated that most of the new reenlistment equations were predicting considerably better than the original equations, which had a mean TIC of 0.228 with a standard deviation of 0.125. Thus, on average, the new equations had a 49% improvement with respect to the TIC statistic. The best value exhibited by an AFS for TIC was 0.048 for AFS 427x5 (Airframe Repair), a very favorable result. The median value was 0.104 for AFS 431x1 (Tactical Aircraft Maintenance), with 46.9% of the equations exhibiting TIC of 0.1 or less.

The variance component averaged 0.155 for the new sample with a standard deviation of 0.128. Both new and original equations reflected similar abilities in forecasting the level of variability in the reenlistment rates. The mean of the variance component for the original equations was 0.151 with a standard deviation of 0.138. Approximately 44% of the first-term reenlistment equations predicted the new sample period with a variance component of less than 0.1. As discussed previously, large upward or downward variations in the quarterly reenlistment rates did occur during the new sample period, often resulting in large prediction errors which weakened the values for SR^2. The variance component indicated that the large upward or downward variations in the reenlistment rates did not dominate the predictions in the new sample.

For the new sample, the covariance component averaged 0.654 with a standard deviation of 0.185. The original equations exhibited a mean value for

covariance of 0.333 with a standard deviation of 0.246. The mean value for covariance improved approximately 96% with the new equations.

Entire Sample Period

The TIC's for the entire sample period averaged 0.128 with a standard deviation of 0.033. The best value of TIC was 0.066, exhibited by AFS 431x2 (Strategic Aircraft Maintenance), while the worst value was 0.285, exhibited by AFS 316x1 (Instrumentation Mechanic). The median TIC for the entire sample was 0.125 for AFS 982x0 (Medical Services Specialist). Approximately 16.8% of the AFSs exhibited a TIC of less than 0.1. The BONUS group exhibited a mean TIC of 0.130 with a standard deviation of 0.036 versus the non-BONUS group mean of 0.126 with a standard deviation of 0.024. Though this is the reverse order of RMSE and SR^2, the mean TIC values are nearly the same with the BONUS group exhibiting a higher standard deviation.

The variance component for the entire sample period exhibited a mean value of 0.123 with a standard deviation of 0.093. The bias statistic averaged 0.016 with a standard deviation of 0.023. The covariance averaged 0.861 with a standard deviation of 0.105. This average value for the covariance component increased slightly for the BONUS group to 0.875 with a standard deviation of 0.108. The mean covariance for the non-BONUS group was 0.830 with a standard deviation of 0.090. The best covariance value for the entire sample period was 0.993 exhibited by AFS 423x4 (Aircraft Pneudraulic Systems Mechanic), a member of the BONUS group. Approximately 41% of the AFSs exhibited a covariance of 0.9 or better.

Fiscal Year Forecasting

Another issue of concern for the reenlistment equations was their ability to predict reenlistment rates by fiscal year. Reenlistment equations may predict quarterly fluctuations well, yet perform poorly at the fiscal year level. In general, the more aggregated the time period to be predicted, e.g., annual or fiscal year versus quarterly, the better the new equations predicted. The fiscal year based TIC calculated for the entire sample period averaged 0.077 with a standard deviation of 0.029. The TIC improved, on average, 39.8% when predicting fiscal year versus quarterly reenlistment rates. In addition, the TIC for each of the AFSs improved when comparing fiscal year versus quarterly predictions. The largest change was 54.6% by AFS 233x0 (Imagery Production), and the least change was 3.8% by AFS 271x2 (Operations Resources Management Specialist). On average, SR^2 improved 34% from 0.507 to 0.680 from quarterly to fiscal year predictions. The mean RMSE improved 41.1%, from 0.122 for the quarterly predictions to 0.072 for the fiscal year predictions.

Comparison of Original and New Equation Forecasting

Table 4 presents a comparison between the validation statistics of the original and new equations, columns 1 and 2. In addition, Table 4 provides the validation statistics for the entire sample period and the fiscal year using the new equations. Comparing columns 1 and 2, the validation statistics for the new equations were better in all cases than those for the original equations. This

Table 4. Comparison of Validation Statistics

(Original Equations vs. New Equations)

	Original equation	New equation		
	New sample	New sample	Entire sample	FY
ME	0.129 (0.131)	0.037 (0.044)[a]	0.003 (0.016)	0.001 (0.017)
Absolute Mean Error	0.187 (0.079)	0.098 (0.030)	0.096 (0.018)	0.057 (0.015)
RMSE	0.217 (0.080)	0.121 (0.039)	0.122 (0.024)	0.072 (0.020)
SR^2	0.041 (.129)	0.306 (0.257)	0.507 (0.139)	0.680 (0.177)
TIC	0.228 (0.125)	0.110 (0.044)	0.128 (0.033)	0.077 (0.029)
Bias	0.516 (0.274)	0.191 (0.181)	0.016 (0.023)	0.034 (0.056)
Variance	0.151 (0.138)	0.155 (0.128)	0.123 (0.093)	0.227 (0.197)
Covariance	0.333 (0.246)	0.654 (.185)	0.861 (0.105)	0.734 (0.214)

[a]Standard Deviation.

indicates the overall improvement in the predictive capability of the new equations during the new sample period. Of course, it should be noted that the predictions for the new sample period using the original equations are out-of-sample predictions whereas the new sample predictions using the new equations are in-sample. An additional test would be to select a time period which is out-of-sample for both sets of equations. However, these data were not available for study in this effort.

One interesting result from the comparison of the new equation predictions between the entire sample and the new sample was the large difference between the mean values for ME, 0.037 and 0.003 for the new and entire samples, respectively.

The large difference in the ME values was not reflected in the means of the absolute value of the MEs, 0.098 and 0.096 for the new and entire samples, respectively. This was caused by the existence of the under-estimation tendency in the new sample period, which was offset when the entire sample period was considered.

IV. CONCLUSION

In the work to validate the reenlistment equations, three central problems were identified:

1. Inability of the equations to predict the relatively high reenlistment rates of the 1980's.

2. Inability of the equations to account for the seemingly unsystematic variations in reenlistment rates among some AFSs.

3. Large variations in selected reenlistment rates due to small numbers of observations per time period.

The re-specification of the reenlistment model directly addressed the first two of these problems. The problem of the small number of reenlistment decisions in some AFSs and time periods was addressed by extending 15 quarters.

Re-estimation of the reenlistment model equations involved:

1. Extending the time period used for estimation to include fiscal years 1982, 1983, 1984, 1985, and the first three quarters of FY86.

2. Calculating the civilian wage using an age-earning function based on age, sex, race, and education level and adjusted for industry wages.

3. Capturing the effect of employment using a quadratic form.

4. Adding seasonality variables to the equations.

5. Adding a variable to account for the change in the general attitude of enlisted personnel since the end of the Vietnam Conflict.

6. Adding two variables to account for the ability of enlisted personnel to alter their date of reenlistment in response to pre-announced changes in the SRB multiple for a particular AFS.

Each of these changes in the specification of the reenlistment equations contributed to improving their overall predictive capability. Four factors which were identified from the research were:

1. The persistent bias which was highly visible in the validation of the original reenlistment equations was reduced by the new equations. Though a bias still exists in the ability of some of the new equations to predict over the new sample period, the bias did not dominate the overall predictive capability of the equations.

2. The more aggregated the time periods, (i.e., fiscal year versus quarterly) the better the equations predicted. Most adjustments to AFSs occur on a monthly or quarterly basis and, thus, the more aggregated the time periods the less the internal personnel adjustments were reflected in the variation of the reenlistment rates.

3. The reenlistment equations for AFSs not receiving reenlistment bonuses did not predict as well as for AFSs receiving reenlistment bonuses. The non-bonus career fields exhibited more unsystematic variation in reenlistment rates.

4. The effect of reenlistment bonuses on reenlistment rates was underestimated unless the altered decision-making due to the pre-announcement of SRB multiple changes was accounted for in the specification of the equations and estimation of the coefficient for bonuses.

Two issues for future research are suggested from the results of this research:

1. Additional analysis should be performed on the AFSs not receiving reenlistment bonuses in order to determine a better specification of the model to account for the internal adjustments made where manning overages have occurred.

2. A well-defined set of criteria should be developed from the validation statistics presented in this analysis to aid analysts in determining when a model is performing poorly enough to warrant re-estimation.

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APPENDIX A: FORECASTING CREDIBILITY STATISTICS

1.1 Goodness of Fit Tests

One way to test the performance of the reenlistment equations is to perform an historical simulation or forecast and examine how closely the dependent variable (e.g., quarterly reenlistment rate) tracks its corresponding historical data series. It is therefore desirable to have some quantitative statistical measure of how closely the predicted reenlistment rates track their corresponding data series. Several measures can be employed for such tests. One measure that is often used is called the Root-Mean-Square Simulation Error (RMSE). (Koutsoyiannis, 1977) The RMSE for the dependent variable Y_t is defined as:

$$\text{RMS error} = \sqrt{\frac{1}{T} \sum_{t=1}^{T} (Y_t^s - Y_t^a)^2} \tag{A-1}$$

where Y_t^s = simulated value of the reenlistment rate in time period t

Y_t^a = actual value of the reenlistment rate in time period t

T = number of time periods in the simulation

The RMSE is a measure of the deviation of the predicted reenlistment rates from their actual rates. Of course, the magnitude of this error can be evaluated only by comparing it with the average size of the reenlistment rate. Another simulation error statistic is the Root-Mean-Square Percent Error (RMSPE), which is defined as:

$$\text{RMS percent error} = \sqrt{\frac{1}{T} \sum_{t=1}^{T} \frac{\left(Y_t^s - Y_t^a\right)^2}{Y_t^a}} \tag{A-2}$$

This is also a measure of the deviation of the predicted reenlistment rates from their actual values but in percentage terms. Two other measures are the mean simulation error, defined as:

$$\text{Mean error} = \frac{1}{T} \sum_{t=1}^{T} (Y_t^s - Y_t^a) \tag{A-3}$$

and the mean percent error, defined as:

$$\text{Mean percent error} = \frac{1}{T} \sum_{t=1}^{T} \frac{\left(Y_t^s - Y_t^a\right)}{Y_t^a} \tag{A-4}$$

The problem with mean errors is that they may be close to 0 if large positive errors cancel out large negative errors. The RMSE would be a better measure of the forecasting performance. Mean absolute errors and mean absolute percent errors (MABSE and MABSPE) can also be calculated to avoid the problem of positive and negative errors canceling, but RMSE's are used more often in practice, since they penalize large individual prediction errors more heavily. The mean errors are useful in identifying a tendency in the prediction for over-estimation or under-estimation.

Note that it is entirely possible for an equation that has a very good statistical fit to have a very poor simulation fit. In an industry market model, for example, an equation which explains the market price of the good being sold (i.e., price is the dependent variable) may have a very good statistical fit (large R^2, small standard errors, etc). At the same time, however, when the model as a whole is simulated, that same price variable might have a very poor simulation fit; i.e., it might have a very large RMSE.

Low RMSE's are only one desirable measure of a simulation fit. Another important criterion is how well the model simulates turning points in the historical data. Consider Figure A-1 where dotted line A represents the historical time series for some endogenous variable X and solid lines B and C represent the simulated values of that same variable using two different models. From that figure alone, one would probably pick the model that produced line C as the better model, since despite its larger RMSE it duplicates the market change in variable X that occurred historically. The model that produced line B failed to predict the turning point, i.e., the sudden change in the historical data. It did track the historical data closely during the rest of the simulation period, but any simple trend model could have done this without really explaining the underlying physical processes. Thus, the ability of a simulation model to duplicate turning points or rapid changes in the actual data is an important criterion for model evaluation.

A useful statistic related to the RMSE and applied to the evaluation of forecasts is Theil's Inequality Coefficient (TIC), defined as:

$$TIC = \frac{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^s - Y_t^a)^2}}{\sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^s)^2} + \sqrt{\frac{1}{T}\sum_{t=1}^{T}(Y_t^a)^2}} \qquad \text{(A-5)}$$

Note that the numerator of TIC is just the RMSE, but the scaling of the denominator is such that TIC will always fall between 0 and 1. If TIC = 0, $Y_t^s = Y_t^a$ for all t and there is a perfect fit. If TIC = 1, on the other hand, the predictive performance of the model is as bad as it

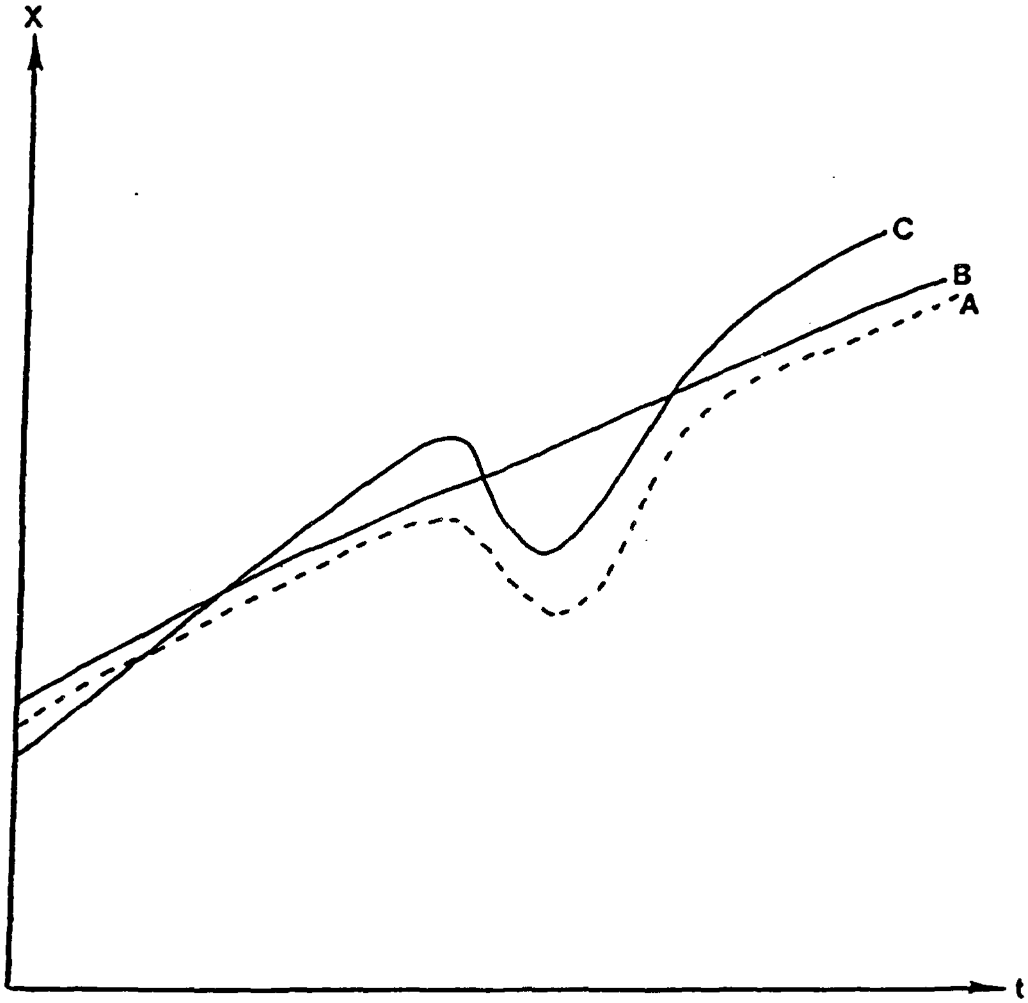

Figure A-1. Simulating Turning Points.

possibly could be. When $TIC = 1$, simulated values are always 0 when actual values are nonzero, or nonzero predictions have been made when actual values are zero and hence easy to predict, or simulated values are positive (negative) when actual values are negative (positive).

TIC can be decomposed in an interesting way. By making a few substitutions, it can be shown algebraically that:

$$\frac{1}{T} \sum (Y_t^s - Y_t^a)^2 = (\bar{Y}^s - \bar{Y}^a) + (\sigma_s - \sigma_a)^2 + 2(1 - \rho)\sigma_s\sigma_a \qquad \text{(A-6)}$$

where $\bar{Y}^s$, $\bar{Y}^a$, σ_s, and σ_a are the means and standard deviations of the series Y_t^s and Y_t^a, respectively, and ρ is their correlation coefficient.[1] We can then define the proportions of inequality as:

$$TIC^M = \frac{(\bar{Y}^s - \bar{Y}^a)^2}{(1/T) \sum (Y_t^s - Y_t^a)^2} \qquad \text{(A-7)}$$

$$TIC^S = \frac{(\sigma_s - \sigma_a)^2}{(1/T) \sum (Y_t^s - Y_t^a)^2} \qquad \text{(A-8)}$$

and

$$TIC^C = \frac{2(1 - \rho)\sigma_s \sigma_a}{(1/T) \sum (Y_t^s - Y_t^a)^2} \qquad \text{(A-9)}$$

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[1] That is, $\rho = (1/\sigma_s \sigma_a T) \sum (Y_t^s - \bar{Y}^s)(Y_t^a - \bar{Y}^a)$.

The proportions of TIC^M, TIC^S, and TIC^C are called the bias, the variance, and the covariance proportions, respectively, and they are useful as a means of breaking the simulation error down into its characteristic sources [$TIC^M + TIC^S + TIC^C = 1$].

The bias proportion TIC^M is an indication of systematic error, since it measures the extent to which the average values of the predicted and actual series deviate from each other. Whatever the value of the inequality coefficient TIC, one would hope that TIC^M would be close to zero. A large value TIC^M (above 0.1 or 0.2), would be quite troubling, since it would mean that a systematic bias is present, so that revision of the model is necessary.

The variance proportion TIC^S indicates the ability of the model to replicate the degree of variability in the variable of interest. If TIC^S is large, it means that the actual series has fluctuated considerably while the simulated series shows little fluctuation, or vice versa. This would also be troubling and might lead us to a revision of the model.

Finally, the covariance proportion measures what might be called unsystematic error; i.e., it represents the remaining error after deviations from average values and average variabilities have been accounted for. Since it is unreasonable to expect predictions that are perfectly correlated with actual outcomes, this component of error is less worrisome. Indeed, for any value of $TIC > 0$, the ideal distribution of inequality over the three sources is $TIC^M = TIC^S = 0$, and $TIC^C = 1$.

1.2 Additional Measures of Forecasting Accuracy

In addition to the above standard measures of forecasting accuracy, three other measures will be employed: Janus Quotient, Simulation R^2, and percent successful predictions. The Janus Quotient provides a comparison between predictive capability in-sample versus

out-of-sample and is defined as the ratio of the average squared differences out-of-sample to the average squared differences in-sample.

$$JQ = \frac{\sum_{i = n+1}^{n + m} (Y_t^s - Y_t^a)^2/m}{\sum_{t = 1}^{n} (Y_t^s - Y_t^a)^2/n} \qquad \text{(A-10)}$$

where n time periods are in-sample and m time periods are out-of-sample. The Janus Quotient ranges between zero and infinity, with a value of one indicating that the structure of the model remains the same in the future as in the period of the in-sample estimation. The higher the value of the Janus Quotient, the poorer the forecasting performance of the model. Values of the Janus Quotient higher than unity are also suggestive, under certain conditions, of changes in the structure of the model.

The Simulation R^2 measures how well the model predicts compared to the actual mean of the dependent variable, and is defined as,

$$SR = 1 - \frac{\sum_{t = 1}^{T} (Y_t^s - Y_t^a)^2}{\sum_{t = 1}^{n} (\bar{Y}_t - Y_t^a)^2} \qquad \text{(A-11)}$$

where $\bar{Y}_t$ is the actual out-of-sample mean value.

For an out-of-sample forecast, the actual out-of-sample mean value is used as a predictor of the actual value for each time period compared with the predicted value for each time period. Of course, in

terms of forecasting, the analyst never knows, a priori, the value for the actual mean of the dependent variable.

The percent successful predictions is only useful for a model which predicts a dichotomous dependent variable (e.g. reenlistment or separation) as does a probit model. This measure provides the proportion of individual decisions which were correctly predicted using the model. In the case of a probit model, when the predicted probability is 0.5 or higher, the individual is assigned a one for the value of the dependent variable, e.g., the airman is predicted to reenlistment. If the predicted probability is less than 0.5, the dependent variable is assigned a zero, e.g., the airman is predicted to separate.

APPENDIX B: FIRST TERM SIMULATIONS

Table B-1. First Term Simulation Over the 1982-1986 Time Period by Quarter (Original Equations)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
1120	0.671	0.806	-0.135	0.252	0.214	0.031	0.164	0.286	0.359	0.356	76.520	13
1140	0.609	0.981	-0.372	0.423	0.372	-3.087	0.260	0.772	0.189	0.039	70.430	32
1220	0.620	0.503	0.117	0.171	0.138	-1.105	0.151	0.467	0.167	0.367	64.370	52
2010	0.596	0.725	-0.129	0.190	0.152	-0.526	0.141	0.462	0.321	0.218	65.550	24
2020	0.566	0.386	0.180	0.251	0.208	-1.757	0.253	0.512	0.013	0.475	61.830	43
2050	0.600	0.405	0.196	0.237	0.209	-0.545	0.226	0.682	0.156	0.162	57.860	23
2060	0.599	0.508	0.091	0.199	0.171	-0.616	0.174	0.207	0.006	0.787	58.940	23
2071	0.545	0.372	0.173	0.241	0.205	-0.265	0.249	0.514	0.255	0.230	61.030	33
2072	0.601	0.290	0.312	0.367	0.332	-3.404	0.396	0.722	0.077	0.201	45.450	23
2083	0.525	0.413	0.113	0.194	0.152	-0.221	0.200	0.336	0.459	0.205	60.180	39
2311	0.602	0.656	-0.054	0.169	0.138	-0.695	0.132	0.102	0.054	0.844	59.680	14
2312	0.619	0.435	0.184	0.256	0.209	-0.782	0.235	0.516	0.299	0.185	60.150	15
2330	0.557	0.454	0.103	0.262	0.195	-0.728	0.248	0.154	0.141	0.705	57.320	14
2510	0.571	0.397	0.174	0.224	0.195	-0.856	0.225	0.601	0.299	0.100	54.630	66
2711	0.602	0.522	0.081	0.153	0.126	-0.299	0.134	0.278	0.326	0.396	52.340	27
2712	0.658	0.585	0.073	0.178	0.144	-0.229	0.141	0.166	0.449	0.385	60.620	39
2720	0.554	0.644	-0.090	0.139	0.112	-0.356	0.115	0.418	0.085	0.497	64.470	130
2740	0.647	0.624	0.024	0.117	0.097	0.384	0.090	0.041	0.035	0.924	65.420	36
2760	0.496	0.575	-0.078	0.158	0.127	-0.400	0.145	0.246	0.207	0.547	62.470	74
3020	0.467	0.372	0.095	0.190	0.136	0.110	0.214	0.251	0.486	0.263	60.000	20
3031	0.388	0.520	-0.133	0.196	0.169	-0.283	0.205	0.460	0.122	0.418	60.490	33
3032	0.499	0.243	0.256	0.299	0.256	-2.380	0.384	0.732	0.094	0.174	52.270	22
3033	0.490	0.230	0.260	0.281	0.260	-5.005	0.383	0.855	0.113	0.032	51.310	29
3041	0.478	0.463	0.015	0.151	0.104	0.461	0.150	0.010	0.152	0.838	64.750	29
3044	0.522	0.393	0.128	0.146	0.128	-0.904	0.156	0.778	0.081	0.141	60.570	140
3054	0.479	0.400	0.079	0.112	0.083	-0.967	0.126	0.498	0.006	0.497	57.080	101
3060	0.521	0.518	0.003	0.111	0.086	0.485	0.103	0.001	0.044	0.956	69.300	62
3061	0.486	0.196	0.289	0.349	0.301	-0.788	0.455	0.688	0.236	0.076	57.350	13
3062	0.587	0.466	0.121	0.162	0.128	-0.939	0.152	0.552	0.111	0.337	62.040	36

Table B-1 (Continued)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
3160	0.602	0.435	0.167	0.197	0.167	-1.623	0.188	0.718	0.149	0.132	64.990	50
3161	0.468	0.161	0.307	0.377	0.320	-1.475	0.535	0.664	0.185	0.151	62.070	9
3163	0.482	0.404	0.078	0.237	0.202	0.139	0.247	0.108	0.460	0.433	60.950	18
3210	0.561	0.382	0.178	0.243	0.189	-0.224	0.243	0.541	0.253	0.206	60.060	19
3212	0.414	0.304	0.110	0.174	0.137	0.187	0.226	0.399	0.458	0.144	67.700	39
3222	0.461	0.347	0.114	0.196	0.150	0.064	0.223	0.340	0.088	0.572	57.780	36
3240	0.425	0.265	0.160	0.230	0.188	-0.125	0.299	0.480	0.163	0.356	60.970	50
3250	0.456	0.288	0.169	0.210	0.178	-0.910	0.272	0.646	0.202	0.152	61.550	43
3251	0.481	0.280	0.201	0.239	0.201	-1.287	0.303	0.709	0.255	0.036	58.770	67
3264	0.552	0.128	0.424	0.461	0.432	------[a]	0.618	0.847	0.000	0.152	48.190	56
3266	0.547	0.286	0.262	0.299	0.263	-2.110	0.344	0.765	0.093	0.142	54.490	51
3280	0.551	0.394	0.158	0.181	0.161	-0.343	0.185	0.760	0.088	0.152	63.350	72
3281	0.530	0.436	0.094	0.139	0.102	-0.013	0.141	0.458	0.190	0.352	57.720	77
3283	0.598	0.414	0.184	0.223	0.193	-1.249	0.214	0.683	0.088	0.230	55.330	128
3284	0.552	0.396	0.156	0.235	0.189	-0.087	0.235	0.442	0.389	0.169	61.420	57
3610	0.492	0.038	0.454	0.472	0.454	-9.375	0.837	0.927	0.058	0.016	49.390	19
3611	0.509	0.369	0.140	0.229	0.207	-0.304	0.243	0.375	0.074	0.550	69.080	17
3621	0.540	0.403	0.137	0.256	0.218	-1.788	0.263	0.283	0.045	0.672	60.240	24
3624	0.490	0.354	0.136	0.204	0.172	-1.953	0.236	0.443	0.055	0.502	60.220	21
3910	0.668	0.466	0.203	0.243	0.217	-2.157	0.210	0.697	0.025	0.278	58.130	19
4111	0.493	0.416	0.078	0.196	0.153	0.166	0.203	0.158	0.456	0.386	66.440	34
4112	0.461	0.493	-0.032	0.137	0.112	0.310	0.138	0.053	0.123	0.824	68.720	32
4230	0.456	0.410	0.047	0.116	0.090	0.433	0.129	0.163	0.538	0.299	66.470	97
4232	0.662	0.557	0.105	0.130	0.108	-0.910	0.106	0.645	0.024	0.331	68.310	27
4233	0.664	0.512	0.152	0.181	0.155	-2.670	0.153	0.703	0.093	0.205	65.810	59
4234	0.569	0.512	0.056	0.123	0.095	0.343	0.111	0.211	0.385	0.404	67.580	85
4235	0.541	0.371	0.170	0.200	0.173	-1.184	0.213	0.720	0.053	0.228	64.630	188
4264	0.600	0.493	0.107	0.123	0.107	-1.325	0.112	0.762	0.074	0.165	65.260	277
4270	0.563	0.377	0.186	0.246	0.208	-1.102	0.254	0.568	0.198	0.234	56.180	15
4271	0.586	0.513	0.073	0.171	0.154	0.148	0.150	0.183	0.207	0.610	69.120	36
4272	0.513	0.559	-0.046	0.149	0.123	0.290	0.134	0.095	0.573	0.332	63.510	21

Table B-1 (Continued)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
4273	0.647	0.474	0.173	0.243	0.194	-2.652	0.213	0.511	0.035	0.454	51.300	24
4274	0.527	0.360	0.167	0.320	0.276	-0.582	0.329	0.272	0.117	0.611	59.570	13
4275	0.571	0.466	0.105	0.123	0.105	-0.280	0.116	0.732	0.050	0.218	66.150	95
4310	0.615	0.482	0.133	0.208	0.177	-0.694	0.185	0.409	0.170	0.421	67.810	30
4311	0.535	0.420	0.115	0.157	0.135	-0.512	0.160	0.538	0.100	0.363	65.320	483
4312	0.509	0.436	0.073	0.117	0.086	0.102	0.121	0.392	0.324	0.284	68.920	257
4610	0.582	0.533	0.049	0.168	0.145	-0.216	0.147	0.085	0.085	0.830	63.550	151
4620	0.504	0.310	0.194	0.227	0.206	0.929	0.267	0.733	0.140	0.127	60.350	280
4721	0.581	0.473	0.108	0.188	0.150	-0.492	0.174	0.332	0.186	0.482	61.230	34
4722	0.603	0.369	-0.238	0.251	0.242	-3.366	0.289	0.827	0.028	0.145	60.880	37
4911	0.580	0.392	0.188	0.207	0.188	-3.810	0.213	0.863	0.067	0.070	57.700	234
4921	0.544	0.578	-0.034	0.179	0.118	0.177	0.155	0.035	0.496	0.469	65.200	37
4930	0.423	0.421	0.002	0.090	0.075	-0.186	0.105	0.000	0.230	0.770	64.480	65
5110	0.580	0.389	0.190	0.224	0.200	-4.555	0.226	0.723	0.000	0.277	58.360	234
5111	0.580	0.261	0.319	0.358	0.325	------[a]	0.403	0.792	0.022	0.185	50.360	234
5420	0.553	0.401	0.152	0.188	0.162	-0.949	0.194	0.648	0.238	0.114	60.900	539
5421	0.465	0.251	-0.214	0.252	0.218	-1.190	0.332	0.725	0.122	0.152	57.300	26
5422	0.593	0.439	0.154	0.173	0.160	-3.150	0.166	0.791	0.003	0.206	60.320	65
5450	0.608	0.397	0.212	0.262	0.227	-0.622	0.250	0.653	0.229	0.119	59.360	45
5452	0.537	0.392	0.145	0.164	0.145	-2.157	0.174	0.779	0.022	0.199	66.920	38
5510	0.501	0.389	0.111	0.166	0.143	-0.745	0.182	0.452	0.131	0.417	66.720	38
5511	0.536	0.378	0.158	0.218	0.181	-0.999	0.232	0.528	0.230	0.242	59.030	52
5520	0.546	0.475	0.071	0.152	0.120	-0.427	0.146	0.218	0.118	0.664	56.120	49
5525	0.506	0.415	0.092	0.142	0.119	-0.584	0.152	0.417	0.112	0.471	66.040	37
5530	0.595	0.467	0.128	0.194	0.150	-0.995	0.179	0.434	0.158	0.409	63.310	26
5661	0.555	0.526	0.029	0.156	0.121	-0.457	0.141	0.033	0.076	0.890	58.150	29
5710	0.497	0.311	0.186	0.205	0.186	-4.112	0.251	0.827	0.112	0.061	58.970	146
6020	0.701	0.555	0.146	0.174	0.153	-5.451	0.137	0.707	0.002	0.291	62.810	30
6021	0.615	0.581	0.033	0.127	0.112	-0.308	0.105	0.069	0.073	0.859	67.740	23
6030	0.596	0.448	0.148	0.184	0.163	-2.675	0.175	0.647	0.072	0.281	58.810	115
6051	0.618	0.458	0.160	0.190	0.175	-3.533	0.176	0.703	0.072	0.225	59.550	95

Table B-1 (Concluded)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
6110	0.680	0.550	0.129	0.198	0.168	-1.316	0.158	0.428	0.051	0.521	60.780	34
6220	0.603	0.426	0.177	0.199	0.182	-3.945	0.192	0.794	0.098	0.109	61.710	89
6310	0.587	0.417	0.170	0.210	0.184	-2.707	0.205	0.654	0.023	0.323	61.080	126
6510	0.742	0.628	0.113	0.162	0.130	-0.619	0.117	0.486	0.234	0.281	69.220	29
6721	0.613	0.125	0.489	0.506	0.489	------[a]	0.670	0.934	0.053	0.014	38.480	48
6722	0.654	0.482	0.173	0.207	0.181	-3.476	0.181	0.693	0.032	0.275	58.640	65
7020	0.694	0.546	0.148	0.162	0.148	-6.029	0.131	0.829	0.049	0.123	64.550	514
7320	0.716	0.506	0.209	0.216	0.209	------[a]	0.177	0.936	0.030	0.034	54.860	151
7411	0.620	0.609	0.010	0.116	0.094	-0.347	0.094	0.008	0.070	0.922	62.400	23
7512	0.789	0.868	-0.079	0.143	0.119	-0.156	0.086	0.303	0.494	0.203	79.930	34
7910	0.481	0.316	0.165	0.292	0.246	-0.234	0.323	0.318	0.113	0.569	63.640	9
8110	0.537	0.340	0.196	0.215	0.196	-3.256	0.242	0.837	0.102	0.061	60.210	520
8112	0.584	0.439	0.145	0.155	0.145	-4.207	0.151	0.880	0.054	0.065	56.380	278
8710	0.681	0.651	0.030	0.160	0.130	-0.769	0.118	0.035	0.007	0.958	63.320	17
9020	0.576	0.216	0.360	0.369	0.360	------[a]	0.461	0.948	0.014	0.038	48.200	200
9022	0.515	0.162	0.353	0.385	0.353	-4.799	0.537	0.848	0.060	0.093	50.700	21
9030	0.486	0.144	0.342	0.370	0.342	-6.049	0.562	0.854	0.057	0.089	53.120	23
9050	0.544	0.322	0.222	0.275	0.233	-1.228	0.301	0.650	0.080	0.270	59.560	18
9060	0.643	0.375	0.268	0.282	0.268	------[a]	0.275	0.906	0.008	0.086	51.570	82
9080	0.616	0.579	0.037	0.161	0.135	-0.132	0.132	0.053	0.264	0.683	61.110	15
9150	0.676	0.365	0.311	0.328	0.311	-8.071	0.311	0.900	0.017	0.083	54.190	23
9240	0.577	0.362	0.214	0.255	0.233	-3.075	0.267	0.704	0.067	0.229	53.500	50
9810	0.566	0.262	0.304	0.324	0.304	-8.040	0.385	0.883	0.047	0.071	48.880	70
9820	0.574	0.321	0.253	0.291	0.253	-2.658	0.316	0.757	0.080	0.163	54.960	15
Mean	0.563	0.427	0.129	0.217	0.187	-0.941	0.228	0.516	0.151	0.333	60.548	78
SD	0.072	0.144	0.131	0.080	0.079	2.665	0.125	0.274	0.138	0.246	6.128	104

[a] SR^2 values below -9.99 were not recorded.

Table B-2. First Term Simulation Over the 1982-1986 Time Period by Quarter (New Equations)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	Observations Per Quarter
1120	0.671	0.711	-0.040	0.203	0.158	0.373	0.141	0.038	0.418	0.544	13
1140	0.607	0.625	-0.018	0.136	0.111	0.591	0.106	0.018	0.284	0.698	32
1220	0.621	0.582	0.039	0.103	0.075	0.225	0.084	0.142	0.219	0.640	51
2010	0.597	0.686	-0.089	0.142	0.108	0.124	0.108	0.395	0.144	0.461	24
2020	0.567	0.487	0.079	0.177	0.141	-0.389	0.162	0.201	0.005	0.795	43
2050	0.598	0.613	-0.014	0.117	0.092	0.633	0.093	0.015	0.306	0.679	23
2060	0.599	0.586	0.012	0.134	0.109	0.266	0.111	0.008	0.180	0.812	23
2071	0.545	0.472	0.073	0.142	0.115	0.564	0.130	0.263	0.076	0.661	33
2072	0.601	0.523	0.078	0.184	0.146	-0.113	0.160	0.180	0.329	0.492	23
2083	0.525	0.555	-0.030	0.153	0.115	0.244	0.137	0.038	0.240	0.722	39
2311	0.602	0.596	0.005	0.148	0.117	-0.302	0.122	0.001	0.033	0.966	14
2312	0.619	0.551	0.067	0.162	0.133	0.288	0.134	0.174	0.378	0.448	15
2330	0.557	0.466	0.092	0.232	0.167	-0.358	0.218	0.155	0.222	0.623	14
2510	0.571	0.586	-0.015	0.145	0.104	0.226	0.123	0.010	0.342	0.647	66
2711	0.602	0.545	0.056	0.138	0.107	-0.053	0.119	0.167	0.345	0.489	27
2712	0.659	0.598	0.061	0.148	0.125	0.151	0.115	0.170	0.435	0.395	39
2720	0.554	0.601	-0.047	0.100	0.080	0.295	0.086	0.214	0.259	0.526	130
2740	0.647	0.646	0.001	0.078	0.069	0.723	0.059	0.000	0.078	0.922	36
2760	0.496	0.500	-0.004	0.105	0.088	0.382	0.103	0.002	0.490	0.509	74
3020	0.467	0.408	0.060	0.119	0.097	0.649	0.127	0.250	0.214	0.536	20
3031	0.388	0.388	-0.001	0.098	0.085	0.681	0.117	0.000	0.147	0.853	33
3032	0.499	0.327	0.171	0.223	0.171	-0.882	0.258	0.591	0.114	0.295	22
3033	0.4[illegible]	0.413	0.075	0.124	0.102	-0.136	0.134	0.371	0.048	0.581	29
3041	0.479	0.535	-0.056	0.131	0.103	0.590	0.121	0.184	0.127	0.689	29
3044	0.522	0.523	-0.001	0.070	0.057	0.563	0.066	0.000	0.045	0.955	140
3054	0.479	0.476	0.003	0.068	0.059	0.284	0.070	0.002	0.002	0.995	101
3060	0.520	0.526	-0.005	0.097	0.065	0.608	0.089	0.003	0.020	0.977	62
3061	0.485	0.368	0.118	0.201	0.168	0.405	0.211	0.343	0.263	0.394	13
3062	0.585	0.545	0.040	0.094	0.060	0.354	0.081	0.183	0.000	0.817	35
3160	0.602	0.569	0.033	0.108	0.091	0.222	0.091	0.095	0.268	0.637	50
3161	0.468	0.265	0.203	0.295	0.235	-0.514	0.368	0.476	0.317	0.207	9
3163	0.482	0.429	0.054	0.153	0.120	0.643	0.151	0.123	0.172	0.706	18

Table B-2 (Continued)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	Observations Per Quarter
3210	0.561	0.506	0.055	0.145	0.124	0.564	0.128	0.145	0.204	0.651	19
3212	0.413	0.362	0.051	0.075	0.064	0.849	0.087	0.457	0.055	0.488	39
3222	0.461	0.472	-0.011	0.100	0.070	0.757	0.078	0.013	0.011	0.976	36
3240	0.424	0.404	0.020	0.135	0.120	0.619	0.149	0.022	0.333	0.645	50
3250	0.456	0.391	0.066	0.127	0.104	0.289	0.143	0.266	0.063	0.671	43
3251	0.481	0.427	0.053	0.093	0.075	0.652	0.098	0.326	0.179	0.495	66
3264	0.552	0.571	-0.018	0.093	0.079	0.494	0.081	0.040	0.086	0.875	56
3266	0.548	0.565	-0.018	0.108	0.091	0.599	0.094	0.027	0.372	0.602	51
3280	0.551	0.530	0.021	0.082	0.070	0.727	0.073	0.068	0.051	0.881	72
3281	0.531	0.537	-0.006	0.075	0.067	0.714	0.068	0.007	0.029	0.964	77
3283	0.598	0.603	-0.005	0.110	0.094	0.445	0.090	0.002	0.101	0.897	128
3284	0.552	0.580	-0.029	0.137	0.124	0.628	0.114	0.043	0.165	0.792	57
3610	0.493	0.400	0.093	0.138	0.118	0.111	0.145	0.455	0.014	0.531	19
3611	0.509	0.470	0.039	0.121	0.104	0.638	0.116	0.106	0.284	0.609	17
3621	0.538	0.446	0.093	0.180	0.136	-0.368	0.177	0.267	0.177	0.556	24
3624	0.490	0.433	0.057	0.117	0.088	0.031	0.124	0.235	0.185	0.580	21
3910	0.669	0.662	0.007	0.120	0.095	0.220	0.089	0.004	0.248	0.749	19
4111	0.493	0.471	0.022	0.162	0.129	0.422	0.160	0.019	0.508	0.473	34
4112	0.458	0.470	-0.012	0.099	0.080	0.641	0.102	0.014	0.292	0.694	32
4230	0.457	0.432	0.025	0.076	0.061	0.756	0.081	0.109	0.058	0.833	97
4232	0.662	0.651	0.011	0.064	0.052	0.536	0.049	0.027	0.091	0.882	27
4233	0.664	0.652	0.011	0.080	0.064	0.295	0.060	0.019	0.195	0.785	59
4234	0.569	0.521	0.047	0.097	0.084	0.587	0.086	0.237	0.015	0.749	85
4235	0.541	0.512	0.029	0.076	0.069	0.684	0.071	0.143	0.108	0.749	188
4264	0.600	0.567	0.034	0.079	0.063	0.041	0.067	0.181	0.025	0.794	277
4270	0.563	0.532	0.031	0.163	0.117	0.079	0.145	0.037	0.183	0.780	15
4271	0.586	0.549	0.037	0.083	0.067	0.798	0.070	0.200	0.059	0.741	36
4272	0.513	0.507	0.006	0.110	0.087	0.610	0.103	0.003	0.137	0.860	21
4273	0.648	0.602	0.046	0.112	0.092	0.204	0.089	0.170	0.091	0.740	24
4274	0.527	0.464	0.063	0.199	0.161	0.390	0.186	0.100	0.354	0.547	13
4275	0.572	0.571	0.001	0.056	0.046	0.736	0.048	0.000	0.035	0.965	95

Table B-2 (Continued)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	Observations Per Quarter
4310	0.618	0.605	0.013	0.145	0.108	0.199	0.116	0.008	0.245	0.747	30
4311	0.534	0.476	0.058	0.108	0.088	0.279	0.104	0.290	0.029	0.681	482
4312	0.509	0.505	0.004	0.071	0.059	0.674	0.068	0.003	0.096	0.901	256
4610	0.583	0.553	0.029	0.106	0.082	0.523	0.090	0.077	0.082	0.841	150
4620	0.504	0.423	0.081	0.125	0.109	0.412	0.129	0.422	0.210	0.367	280
4721	0.581	0.570	0.011	0.126	0.110	0.322	0.107	0.007	0.164	0.829	34
4722	0.603	0.538	0.065	0.115	0.094	0.124	0.099	0.319	0.291	0.390	37
4911	0.579	0.575	0.005	0.075	0.066	0.383	0.064	0.004	0.055	0.941	234
4912	0.565	0.597	-0.032	0.124	0.105	0.235	0.105	0.067	0.217	0.716	49
4921	0.545	0.588	-0.043	0.165	0.129	0.309	0.141	0.067	0.478	0.455	37
4930	0.423	0.384	0.040	0.064	0.047	0.397	0.078	0.386	0.222	0.393	65
5420	0.553	0.463	0.090	0.140	0.118	-0.101	0.136	0.415	0.270	0.315	39
5421	0.466	0.420	0.046	0.113	0.087	0.554	0.120	0.164	0.003	0.833	26
5422	0.593	0.545	0.048	0.093	0.083	-0.192	0.081	0.271	0.004	0.726	65
5450	0.608	0.558	0.050	0.145	0.117	0.500	0.120	0.120	0.251	0.629	45
5452	0.537	0.451	0.086	0.100	0.090	-0.187	0.099	0.741	0.001	0.258	38
5510	0.501	0.440	0.061	0.114	0.094	0.158	0.118	0.286	0.185	0.529	37
5520	0.546	0.476	0.071	0.114	0.092	0.194	0.109	0.381	0.080	0.539	49
5525	0.508	0.420	0.088	0.111	0.097	0.018	0.117	0.628	0.025	0.347	37
5530	0.594	0.601	-0.007	0.103	0.084	0.432	0.085	0.005	0.137	0.858	26
5661	0.555	0.491	0.064	0.132	0.097	-0.068	0.124	0.235	0.027	0.739	29
5710	0.496	0.406	0.090	0.116	0.102	-0.631	0.127	0.595	0.076	0.330	146
6020	0.701	0.651	0.051	0.104	0.080	-1.319	0.077	0.235	0.002	0.763	30
6021	0.615	0.570	0.045	0.117	0.097	-0.100	0.097	0.147	0.075	0.778	23
6030	0.596	0.512	0.084	0.110	0.095	-0.287	0.098	0.586	0.050	0.364	115
6051	0.618	0.535	0.083	0.111	0.102	-0.541	0.095	0.560	0.030	0.410	95
6110	0.679	0.601	0.079	0.155	0.126	-0.410	0.119	0.257	0.056	0.687	34
6220	0.603	0.554	0.049	0.106	0.086	-0.361	0.091	0.216	0.007	0.777	89
6310	0.587	0.509	0.078	0.136	0.109	-0.575	0.123	0.324	0.119	0.557	126
6510	0.742	0.747	-0.005	0.094	0.079	0.461	0.062	0.003	0.254	0.743	29
6721	0.613	0.572	0.041	0.116	0.094	0.280	0.096	0.128	0.488	0.384	48

Table B-2 (Concluded)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	Observations Per Quarter
6722	0.655	0.604	0.052	0.098	0.080	0.020	0.077	0.278	0.176	0.546	65
7020	0.694	0.622	0.072	0.091	0.079	-1.197	0.068	0.626	0.000	0.374	514
7320	0.716	0.678	0.039	0.077	0.062	-0.785	0.055	0.252	0.006	0.742	151
7411	0.620	0.605	0.015	0.089	0.069	0.204	0.072	0.029	0.063	0.909	23
7512	0.789	0.822	-0.033	0.086	0.065	0.580	0.053	0.143	0.223	0.634	34
7910	0.481	0.400	0.081	0.217	0.173	0.320	0.219	0.138	0.127	0.735	9
8110	0.537	0.457	0.080	0.110	0.095	-0.111	0.109	0.524	0.029	0.446	519
8112	0.584	0.517	0.067	0.086	0.076	-0.593	0.077	0.615	0.007	0.378	278
8710	0.681	0.620	0.061	0.098	0.084	0.337	0.074	0.387	0.045	0.568	17
9020	0.576	0.536	0.041	0.077	0.064	0.011	0.069	0.278	0.016	0.707	200
9022	0.515	0.525	-0.010	0.143	0.118	0.192	0.134	0.005	0.228	0.767	21
9030	0.486	0.436	0.051	0.123	0.103	0.227	0.129	0.170	0.126	0.704	23
9050	0.546	0.498	0.048	0.144	0.124	0.393	0.132	0.112	0.214	0.674	18
9060	0.643	0.580	0.064	0.107	0.079	-1.530	0.087	0.353	0.003	0.645	82
9080	0.619	0.561	0.057	0.140	0.117	0.160	0.116	0.168	0.304	0.528	15
9150	0.676	0.630	0.046	0.100	0.085	0.154	0.076	0.206	0.077	0.717	23
9240	0.576	0.488	0.088	0.138	0.114	-0.186	0.127	0.408	0.127	0.465	50
9810	0.566	0.499	0.067	0.104	0.093	0.065	0.096	0.415	0.091	0.494	70
9820	0.577	0.564	0.013	0.128	0.104	0.279	0.110	0.010	0.193	0.797	15
Mean	0.564	0.527	0.037	0.121	0.098	0.197	0.110	0.191	0.155	0.654	71
SD	0.072	0.089	0.044	0.039	0.030	0.453	0.044	0.181	0.128	0.185	93

Table B-3. First Term Simulation Over the 1975-1986 Time Period by Quarter (New Equations)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
1120	0.610	0.647	-0.038	0.158	0.121	0.462	0.121	0.057	0.161	0.782	70.73	18
1140	0.677	0.708	-0.032	0.142	0.105	0.457	0.100	0.050	0.215	0.736	72.17	37
1220	0.489	0.506	-0.018	0.111	0.086	0.493	0.107	0.025	0.066	0.909	69.50	46
2010	0.613	0.658	-0.044	0.132	0.099	0.340	0.102	0.112	0.129	0.759	70.47	26
2020	0.430	0.412	0.018	0.138	0.105	0.395	0.153	0.017	0.035	0.948	72.64	45
2050	0.428	0.444	-0.017	0.137	0.100	0.624	0.141	0.015	0.031	0.954	71.98	20
2060	0.475	0.466	0.009	0.160	0.118	0.485	0.157	0.003	0.137	0.860	69.31	21
2071	0.409	0.398	0.011	0.117	0.095	0.695	0.131	0.009	0.159	0.832	75.37	38
2072	0.428	0.433	-0.006	0.146	0.115	0.463	0.159	0.001	0.257	0.742	67.40	21
2083	0.426	0.434	-0.009	0.122	0.089	0.529	0.132	0.005	0.055	0.940	71.39	57
2311	0.542	0.548	-0.006	0.152	0.119	0.257	0.134	0.001	0.040	0.959	70.24	16
2312	0.528	0.512	0.016	0.167	0.136	0.300	0.153	0.009	0.195	0.796	70.24	16
2330	0.440	0.425	0.015	0.187	0.145	0.183	0.202	0.007	0.312	0.682	67.09	17
2510	0.478	0.492	-0.015	0.133	0.099	0.496	0.130	0.012	0.200	0.788	68.24	66
2711	0.517	0.505	0.012	0.117	0.091	0.340	0.111	0.010	0.188	0.802	64.14	37
2712	0.593	0.569	0.023	0.140	0.116	0.238	0.118	0.027	0.378	0.595	63.10	38
2720	0.526	0.540	-0.014	0.114	0.092	0.256	0.105	0.015	0.177	0.808	66.91	141
2740	0.663	0.682	-0.019	0.118	0.090	0.541	0.085	0.027	0.279	0.694	72.84	42
2760	0.457	0.462	-0.005	0.093	0.074	0.543	0.098	0.003	0.107	0.890	68.90	92
3020	0.372	0.364	0.008	0.139	0.113	0.465	0.172	0.003	0.122	0.875	71.44	21
3031	0.371	0.367	0.004	0.110	0.091	0.541	0.139	0.002	0.115	0.884	71.23	37
3032	0.328	0.268	0.060	0.167	0.123	0.299	0.249	0.130	0.338	0.532	75.40	36
3033	0.362	0.348	0.014	0.114	0.095	0.534	0.148	0.016	0.107	0.877	72.73	33
3041	0.459	0.474	-0.016	0.135	0.105	0.544	0.135	0.014	0.153	0.834	70.02	30
3044	0.386	0.381	0.005	0.092	0.074	0.668	0.111	0.003	0.009	0.989	71.51	138
3054	0.404	0.393	0.011	0.072	0.061	0.728	0.086	0.022	0.085	0.893	68.85	87
3060	0.441	0.421	0.020	0.115	0.084	0.526	0.125	0.030	0.032	0.938	71.33	67
3061	0.347	0.318	0.029	0.146	0.111	0.609	0.189	0.039	0.270	0.691	74.00	16
3062	0.417	0.400	0.017	0.103	0.076	0.687	0.116	0.028	0.028	0.944	72.99	43
3160	0.394	0.382	0.012	0.096	0.079	0.745	0.113	0.016	0.171	0.813	74.93	63
3161	0.505	0.246	0.059	0.174	0.116	0.114	0.285	0.113	0.449	0.438	75.46	27
3163	0.377	0.375	0.002	0.162	0.129	0.437	0.194	0.000	0.182	0.818	71.53	22

Table B-3 (Continued)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
3210	0.406	0.390	0.017	0.122	0.094	0.669	0.138	0.019	0.149	0.832	74.02	20
3212	0.322	0.308	0.014	0.085	0.068	0.764	0.119	0.025	0.082	0.892	75.94	60
3222	0.377	0.389	-0.011	0.134	0.094	0.603	0.156	0.007	0.067	0.926	73.36	29
3240	0.358	0.366	-0.008	0.117	0.098	0.675	0.143	0.004	0.093	0.903	73.43	56
3250	0.358	0.344	0.014	0.119	0.097	0.517	0.157	0.013	0.217	0.770	72.02	39
3251	0.341	0.330	0.011	0.112	0.089	0.610	0.150	0.009	0.130	0.861	72.20	62
3264	0.391	0.382	0.009	0.114	0.089	0.709	0.131	0.006	0.033	0.960	73.37	42
3266	0.402	0.387	0.015	0.143	0.121	0.552	0.162	0.011	0.076	0.914	74.20	38
3280	0.390	0.397	-0.006	0.136	0.101	0.547	0.156	0.002	0.052	0.946	71.43	63
3281	0.423	0.418	0.005	0.091	0.071	0.703	0.101	0.003	0.016	0.981	69.82	67
3283	0.426	0.409	0.017	0.143	0.108	0.516	0.154	0.014	0.006	0.980	73.05	92
3284	0.389	0.381	0.009	0.126	0.099	0.668	0.143	0.005	0.005	0.991	76.10	52
3610	0.375	0.356	0.020	0.133	0.114	0.472	0.165	0.022	0.033	0.945	75.24	20
3611	0.441	0.459	-0.018	0.161	0.129	0.418	0.166	0.012	0.151	0.837	72.97	20
3621	0.428	0.407	0.021	0.140	0.106	0.392	0.157	0.022	0.129	0.849	70.17	29
3624	0.458	0.437	0.021	0.128	0.101	0.384	0.137	0.028	0.145	0.827	69.32	27
3910	0.641	0.627	0.014	0.180	0.130	0.315	0.135	0.006	0.034	0.959	74.78	17
4111	0.433	0.429	0.004	0.162	0.131	0.250	0.177	0.000	0.276	0.723	69.81	40
4112	0.399	0.414	-0.015	0.129	0.102	0.404	0.149	0.013	0.036	0.951	74.58	29
4230	0.383	0.383	0.000	0.080	0.064	0.657	0.098	0.000	0.011	0.989	72.67	84
4232	0.509	0.524	-0.016	0.093	0.074	0.734	0.085	0.028	0.008	0.964	71.61	28
4233	0.512	0.511	0.000	0.123	0.095	0.440	0.115	0.000	0.016	0.984	73.04	47
4234	0.447	0.445	0.002	0.102	0.085	0.532	0.109	0.000	0.006	0.993	71.57	78
4235	0.451	0.463	-0.012	0.087	0.075	0.613	0.091	0.017	0.016	0.966	71.25	173
4264	0.482	0.493	-0.011	0.106	0.083	0.441	0.105	0.011	0.050	0.939	71.25	251
4270	0.465	0.446	0.019	0.133	0.100	0.612	0.135	0.020	0.161	0.820	69.28	18
4271	0.472	0.485	-0.013	0.113	0.086	0.640	0.110	0.014	0.020	0.967	73.65	34
4272	0.504	0.501	0.003	0.121	0.098	0.385	0.116	0.000	0.099	0.900	66.63	19
4273	0.505	0.516	-0.011	0.126	0.096	0.533	0.117	0.007	0.095	0.898	68.48	21
4274	0.443	0.444	-0.001	0.179	0.146	0.331	0.187	0.000	0.208	0.792	68.40	17
4275	0.439	0.430	0.009	0.091	0.071	0.629	0.099	0.010	0.013	0.978	73.65	81

Table B-3 (Continued)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
4310	0.503	0.507	-0.004	0.120	0.089	0.533	0.113	0.001	0.115	0.884	70.07	32
4311	0.435	0.428	0.008	0.087	0.070	0.629	0.096	0.008	0.011	0.981	72.20	575
4312	0.437	0.431	0.006	0.060	0.050	0.813	0.066	0.010	0.006	0.984	72.62	343
4610	0.496	0.508	-0.013	0.121	0.098	0.489	0.115	0.011	0.100	0.889	67.99	141
4620	0.386	0.378	0.008	0.103	0.085	0.574	0.126	0.006	0.166	0.827	71.01	312
4721	0.519	0.525	-0.006	0.111	0.096	0.486	0.103	0.003	0.135	0.862	68.86	34
4722	0.488	0.472	0.016	0.112	0.093	0.649	0.111	0.021	0.231	0.748	68.75	43
4911	0.488	0.494	-0.006	0.077	0.067	0.644	0.076	0.006	0.039	0.955	67.34	251
4912	0.489	0.511	-0.022	0.123	0.099	0.465	0.117	0.032	0.100	0.869	65.47	43
4921	0.490	0.508	-0.018	0.136	0.106	0.433	0.130	0.017	0.153	0.830	67.99	33
4930	0.347	0.331	0.016	0.085	0.064	0.553	0.120	0.037	0.198	0.765	71.56	60
5420	0.435	0.418	0.017	0.114	0.090	0.437	0.129	0.022	0.303	0.675	68.51	40
5421	0.379	0.374	0.005	0.130	0.099	0.475	0.157	0.002	0.008	0.991	74.86	22
5422	0.430	0.417	0.013	0.095	0.077	0.704	0.104	0.019	0.038	0.943	72.42	66
5450	0.468	0.464	0.004	0.136	0.108	0.623	0.134	0.001	0.116	0.883	71.31	46
5452	0.401	0.397	0.004	0.115	0.100	0.464	0.135	0.001	0.047	0.951	73.52	40
5510	0.413	0.388	0.025	0.101	0.080	0.573	0.120	0.061	0.178	0.761	71.11	41
5520	0.445	0.438	0.008	0.112	0.091	0.475	0.121	0.005	0.093	0.902	67.15	48
5525	0.392	0.378	0.014	0.119	0.097	0.403	0.147	0.015	0.151	0.835	71.49	38
5530	0.505	0.514	-0.009	0.138	0.109	0.432	0.129	0.004	0.118	0.878	72.13	24
5661	0.435	0.427	0.008	0.130	0.103	0.377	0.143	0.003	0.057	0.940	72.73	25
5710	0.360	0.345	0.015	0.087	0.071	0.621	0.116	0.030	0.146	0.824	73.06	158
6020	0.567	0.581	-0.014	0.111	0.084	0.492	0.094	0.015	0.107	0.878	70.79	28
6021	0.502	0.509	-0.007	0.128	0.109	0.401	0.122	0.003	0.200	0.796	66.21	22
6030	0.465	0.448	0.017	0.113	0.093	0.479	0.119	0.023	0.147	0.830	68.43	128
6051	0.468	0.469	-0.001	0.119	0.101	0.449	0.122	0.000	0.153	0.847	68.27	84
6110	0.567	0.575	-0.008	0.155	0.127	0.228	0.131	0.003	0.254	0.743	67.37	26
6220	0.497	0.500	-0.004	0.099	0.083	0.587	0.095	0.001	0.021	0.978	69.17	78
6310	0.458	0.454	0.004	0.121	0.097	0.351	0.127	0.001	0.086	0.913	69.21	135
6510	0.679	0.704	-0.025	0.125	0.102	0.427	0.089	0.039	0.414	0.547	72.47	28
6721	0.482	0.488	-0.006	0.114	0.090	0.540	0.112	0.003	0.152	0.845	65.72	44

Table B-3 (Concluded)

AFSC	Actual Reenlistment Rate	Predicted Reenlistment Rate	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance	PSP	Observations Per Quarter
6722	0.493	0.491	0.002	0.085	0.064	0.778	0.082	0.001	0.075	0.924	72.20	80
7020	0.553	0.554	-0.002	0.097	0.079	0.536	0.085	0.000	0.103	0.897	67.08	542
7320	0.620	0.635	-0.014	0.100	0.077	0.440	0.078	0.021	0.124	0.855	66.35	139
7411	0.544	0.547	-0.003	0.113	0.092	0.275	0.101	0.001	0.079	0.921	68.44	22
7512	0.759	0.796	-0.037	0.142	0.099	0.420	0.090	0.068	0.204	0.727	82.07	21
7910	0.476	0.465	0.011	0.160	0.119	0.496	0.156	0.004	0.056	0.939	70.21	15
8110	0.390	0.388	0.002	0.108	0.085	0.571	0.128	0.000	0.020	0.980	71.50	525
8112	0.476	0.450	0.026	0.152	0.102	0.245	0.156	0.028	0.201	0.771	66.57	230
8710	0.538	0.529	0.009	0.121	0.100	0.625	0.108	0.005	0.059	0.936	68.45	20
9020	0.440	0.438	0.002	0.098	0.080	0.568	0.107	0.000	0.099	0.901	69.71	205
9022	0.383	0.384	0.000	0.117	0.092	0.596	0.140	0.000	0.104	0.896	71.86	24
9030	0.391	0.354	0.038	0.130	0.107	0.332	0.164	0.083	0.175	0.741	69.92	30
9050	0.424	0.422	0.002	0.124	0.097	0.575	0.136	0.000	0.085	0.915	70.61	20
9060	0.511	0.514	-0.003	0.103	0.082	0.466	0.098	0.001	0.082	0.918	66.68	78
9080	0.501	0.497	0.004	0.123	0.100	0.493	0.119	0.001	0.320	0.679	66.39	18
9150	0.529	0.530	-0.002	0.100	0.081	0.652	0.090	0.000	0.132	0.868	69.29	26
9240	0.409	0.403	0.006	0.124	0.104	0.496	0.144	0.002	0.211	0.787	68.93	54
9810	0.407	0.412	-0.004	0.102	0.081	0.637	0.116	0.002	0.099	0.899	70.73	67
9820	0.463	0.466	-0.003	0.124	0.101	0.597	0.125	0.000	0.045	0.955	72.32	18
Mean	0.458	0.456	0.003	0.122	0.096	0.507	0.128	0.016	0.123	0.861	70.80	72
SD	0.081	0.091	0.016	0.024	0.018	0.139	0.033	0.023	0.093	0.105	2.90	99

Table B-4. First Term Simulation Over the 1975-1986 Time Period by Fiscal Year (New Equations)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance
1120	0.661	0.701	-0.041	0.079	0.061	0.687	0.057	0.260	0.161	0.579
1140	0.710	0.739	-0.028	0.079	0.057	0.750	0.054	0.128	0.650	0.222
1220	0.483	0.501	-0.018	0.076	0.053	0.632	0.076	0.055	0.331	0.613
2010	0.657	0.678	-0.020	0.056	0.045	0.653	0.042	0.131	0.113	0.755
2020	0.443	0.440	0.002	0.075	0.067	0.707	0.081	0.001	0.006	0.993
2050	0.455	0.458	-0.003	0.090	0.062	0.783	0.091	0.001	0.044	0.955
2060	0.465	0.460	0.006	0.059	0.050	0.874	0.060	0.009	0.035	0.956
2071	0.417	0.425	-0.008	0.068	0.053	0.876	0.075	0.013	0.747	0.240
2072	0.438	0.442	-0.003	0.111	0.100	0.521	0.122	0.001	0.500	0.499
2083	0.450	0.453	-0.003	0.047	0.037	0.876	0.049	0.005	0.066	0.929
2311	0.548	0.548	0.000	0.065	0.053	0.312	0.059	0.000	0.076	0.924
2312	0.511	0.507	0.004	0.070	0.061	0.579	0.068	0.003	0.573	0.423
2330	0.432	0.415	0.018	0.080	0.063	0.516	0.092	0.048	0.408	0.544
2510	0.491	0.509	-0.018	0.051	0.035	0.885	0.049	0.125	0.352	0.524
2711	0.496	0.497	-0.002	0.057	0.043	0.582	0.057	0.001	0.211	0.788
2712	0.581	0.548	0.033	0.130	0.091	-0.502	0.114	0.065	0.141	0.794
2720	0.543	0.544	-0.001	0.045	0.036	0.730	0.041	0.000	0.160	0.840
2740	0.672	0.695	-0.023	0.080	0.058	0.685	0.057	0.086	0.339	0.575
2760	0.479	0.487	-0.008	0.052	0.041	0.772	0.053	0.021	0.181	0.798
3020	0.379	0.376	0.003	0.069	0.052	0.712	0.087	0.001	0.063	0.935
3031	0.390	0.378	0.012	0.065	0.048	0.609	0.082	0.032	0.092	0.876
3032	0.316	0.266	0.049	0.116	0.092	0.536	0.181	0.179	0.411	0.410
3033	0.348	0.336	0.012	0.072	0.064	0.733	0.100	0.028	0.398	0.573
3041	0.507	0.504	0.003	0.063	0.048	0.812	0.060	0.002	0.080	0.918
3044	0.382	0.372	0.010	0.056	0.048	0.877	0.068	0.033	0.038	0.929
3054	0.395	0.379	0.015	0.036	0.030	0.890	0.044	0.185	0.010	0.806
3060	0.459	0.444	0.015	0.073	0.056	0.749	0.077	0.043	0.040	0.916
3061	0.352	0.328	0.024	0.077	0.062	0.828	0.103	0.094	0.393	0.513
3062	0.407	0.393	0.014	0.069	0.058	0.779	0.081	0.041	0.176	0.783
3160	0.411	0.397	0.015	0.042	0.034	0.929	0.048	0.128	0.198	0.674
3161	0.328	0.241	0.087	0.162	0.103	-0.072	0.266	0.291	0.509	0.200

Table B-4 (Continued)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance
3163	0.399	0.403	-0.004	0.119	0.086	0.568	0.138	0.001	0.158	0.840
3210	0.408	0.391	0.017	0.051	0.042	0.925	0.058	0.115	0.195	0.690
3212	0.338	0.321	0.018	0.052	0.043	0.887	0.072	0.115	0.128	0.757
3222	0.388	0.404	-0.015	0.083	0.064	0.832	0.095	0.034	0.213	0.753
3240	0.390	0.381	0.009	0.069	0.058	0.884	0.081	0.016	0.422	0.562
3250	0.362	0.353	0.008	0.068	0.058	0.752	0.090	0.015	0.169	0.816
3251	0.339	0.332	0.007	0.066	0.055	0.811	0.091	0.011	0.073	0.917
3264	0.395	0.387	0.008	0.069	0.051	0.868	0.080	0.014	0.009	0.977
3266	0.422	0.390	0.033	0.111	0.090	0.683	0.124	0.086	0.042	0.872
3280	0.385	0.389	-0.004	0.074	0.060	0.848	0.087	0.003	0.067	0.930
3281	0.423	0.419	0.004	0.040	0.032	0.919	0.045	0.009	0.007	0.984
3283	0.410	0.405	0.005	0.074	0.059	0.834	0.083	0.004	0.003	0.993
3284	0.391	0.377	0.014	0.054	0.045	0.922	0.062	0.070	0.008	0.922
3610	0.390	0.377	0.013	0.091	0.077	0.694	0.110	0.022	0.122	0.856
3611	0.480	0.489	-0.009	0.106	0.086	0.455	0.106	0.007	0.131	0.862
3621	0.424	0.414	0.010	0.098	0.084	0.514	0.112	0.010	0.193	0.797
3624	0.457	0.437	0.020	0.087	0.077	0.413	0.094	0.055	0.075	0.870
3910	0.639	0.628	0.010	0.094	0.075	0.681	0.072	0.012	0.003	0.985
4111	0.437	0.438	0.000	0.087	0.063	0.547	0.097	0.000	0.255	0.745
4112	0.423	0.425	-0.001	0.069	0.053	0.480	0.080	0.000	0.021	0.979
4230	0.398	0.402	-0.004	0.035	0.028	0.921	0.042	0.014	0.001	0.985
4232	0.517	0.527	-0.011	0.068	0.061	0.797	0.063	0.025	0.010	0.965
4233	0.497	0.508	-0.012	0.073	0.051	0.747	0.070	0.025	0.017	0.957
4234	0.468	0.474	-0.006	0.056	0.046	0.832	0.057	0.013	0.053	0.934
4235	0.463	0.480	-0.017	0.059	0.044	0.759	0.061	0.082	0.084	0.835
4264	0.487	0.496	-0.009	0.074	0.061	0.632	0.073	0.013	0.151	0.836
4270	0.466	0.448	0.018	0.045	0.034	0.878	0.047	0.163	0.193	0.645
4271	0.489	0.510	-0.021	0.080	0.063	0.676	0.077	0.067	0.000	0.932
4272	0.525	0.516	0.009	0.054	0.038	0.671	0.051	0.030	0.006	0.964
4273	0.516	0.519	-0.003	0.068	0.055	0.756	0.064	0.002	0.381	0.617
4274	0.459	0.462	-0.003	0.076	0.059	0.645	0.080	0.001	0.297	0.702

Table B-4 (Continued)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance
4275	0.443	0.441	0.002	0.061	0.050	0.820	0.066	0.001	0.002	0.997
4310	0.481	0.479	0.003	0.072	0.063	0.696	0.073	0.001	0.001	0.998
4311	0.439	0.432	0.007	0.057	0.042	0.784	0.063	0.014	0.006	0.980
4312	0.438	0.429	0.009	0.050	0.043	0.863	0.055	0.034	0.018	0.949
4610	0.498	0.525	-0.027	0.088	0.068	0.588	0.083	0.095	0.284	0.622
4620	0.391	0.389	0.002	0.072	0.058	0.719	0.088	0.001	0.181	0.818
4721	0.542	0.537	0.005	0.086	0.062	0.468	0.078	0.003	0.106	0.891
4722	0.463	0.465	-0.002	0.055	0.044	0.782	0.057	0.001	0.257	0.742
4911	0.489	0.492	-0.003	0.039	0.035	0.837	0.039	0.007	0.257	0.737
4912	0.508	0.525	-0.017	0.074	0.056	0.740	0.069	0.055	0.400	0.545
4921	0.506	0.507	-0.001	0.055	0.049	0.772	0.053	0.001	0.021	0.979
4930	0.331	0.323	0.008	0.048	0.040	0.664	0.072	0.026	0.106	0.868
5420	0.433	0.415	0.018	0.079	0.055	0.535	0.091	0.050	0.627	0.323
5421	0.394	0.392	0.003	0.075	0.055	0.751	0.089	0.001	0.001	0.998
5422	0.425	0.422	0.003	0.047	0.037	0.920	0.052	0.003	0.106	0.890
5450	0.443	0.458	-0.014	0.065	0.051	0.826	0.069	0.049	0.290	0.661
5452	0.389	0.390	-0.001	0.091	0.082	0.499	0.112	0.000	0.162	0.838
5510	0.416	0.385	0.031	0.072	0.062	0.552	0.087	0.191	0.442	0.367
5520	0.426	0.428	-0.001	0.068	0.058	0.564	0.078	0.000	0.407	0.592
5525	0.384	0.374	0.010	0.073	0.065	0.407	0.095	0.019	0.421	0.560
5530	0.519	0.521	-0.002	0.068	0.059	0.791	0.064	0.001	0.194	0.805
5661	0.420	0.417	0.003	0.084	0.062	0.575	0.097	0.001	0.281	0.718
5710	0.350	0.341	0.009	0.057	0.044	0.716	0.079	0.027	0.384	0.589
6020	0.564	0.576	-0.012	0.073	0.058	0.590	0.063	0.027	0.184	0.789
6021	0.485	0.493	-0.008	0.076	0.067	0.455	0.076	0.012	0.283	0.706
6030	0.455	0.449	0.006	0.078	0.069	0.609	0.084	0.006	0.690	0.304
6051	0.451	0.466	-0.015	0.093	0.085	0.427	0.099	0.025	0.328	0.648
6110	0.542	0.574	-0.032	0.099	0.083	0.354	0.087	0.103	0.670	0.226
6220	0.480	0.486	-0.007	0.064	0.050	0.718	0.064	0.011	0.171	0.818
6310	0.456	0.458	-0.002	0.097	0.073	0.215	0.104	0.001	0.114	0.886
6510	0.689	0.714	-0.025	0.080	0.065	0.601	0.056	0.101	0.547	0.351

Table B-4 (Concluded)

AFSC	Actual Reenlistment Rates	Predicted Reenlistment Rates	Mean Error	RMSE	Absolute ERROR	SR^2	TIC	Bias	Variance	Covariance
6721	0.476	0.485	-0.009	0.083	0.062	0.560	0.084	0.013	0.155	0.832
6722	0.493	0.486	0.007	0.037	0.028	0.935	0.037	0.037	0.453	0.510
7020	0.544	0.554	-0.010	0.066	0.056	0.714	0.059	0.023	0.563	0.414
7320	0.620	0.631	-0.010	0.058	0.046	0.642	0.046	0.033	0.543	0.424
7411	0.540	0.557	-0.017	0.063	0.055	0.452	0.057	0.074	0.389	0.538
7512	0.768	0.811	-0.043	0.102	0.068	0.561	0.064	0.177	0.333	0.491
7910	0.513	0.522	-0.009	0.057	0.046	0.841	0.053	0.026	0.023	0.952
8110	0.387	0.386	0.001	0.081	0.066	0.664	0.100	0.000	0.035	0.965
8112	0.463	0.448	0.015	0.097	0.077	0.410	0.104	0.025	0.264	0.711
8710	0.531	0.524	0.007	0.073	0.059	0.749	0.067	0.009	0.324	0.668
9020	0.439	0.432	0.006	0.073	0.058	0.564	0.081	0.007	0.206	0.787
9022	0.378	0.377	0.001	0.061	0.048	0.775	0.077	0.000	0.025	0.975
9030	0.369	0.354	0.014	0.066	0.058	0.651	0.089	0.047	0.458	0.496
9050	0.431	0.434	-0.003	0.068	0.048	0.749	0.075	0.001	0.062	0.937
9060	0.502	0.511	-0.009	0.071	0.061	0.536	0.069	0.016	0.549	0.435
9080	0.498	0.498	0.000	0.054	0.047	0.725	0.053	0.000	0.585	0.415
9150	0.526	0.534	-0.007	0.075	0.056	0.731	0.069	0.009	0.576	0.415
9240	0.398	0.405	-0.007	0.093	0.074	0.528	0.111	0.006	0.497	0.497
9810	0.405	0.407	-0.003	0.070	0.059	0.756	0.082	0.002	0.551	0.448
9820	0.463	0.469	-0.006	0.054	0.045	0.744	0.057	0.013	0.102	0.885
Mean	0.462	0.461	0.001	0.072	0.057	0.680	0.077	0.039	0.227	0.734
SD	0.083	0.094	0.017	0.020	0.015	0.177	0.029	0.056	0.197	0.214